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WAR MACHINE

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99p 133
IR £1.25 Aus $2.15 NZ $2.65 Sing $4.50

Ground Attack in 1918

The Birth of Strategic Bombing
Airco D.H.4 and D.H.9 in Action
Armed Forces of the World: Finland

A fully illustrated guide to Bombers of World War I

WAR MACHINE

Volume 12 **Issue 133**

Published by
Orbis Publishing Ltd
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Colour profiles, diagrams and cutaway
drawings © Pilot Press Ltd

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Colour Origination: Imago Publishing Ltd,
Thame, Oxon

Typesetting: SX Composing Ltd

Film work: Precise Litho Ltd

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20863

Printed in Great Britain
by The Color Factory

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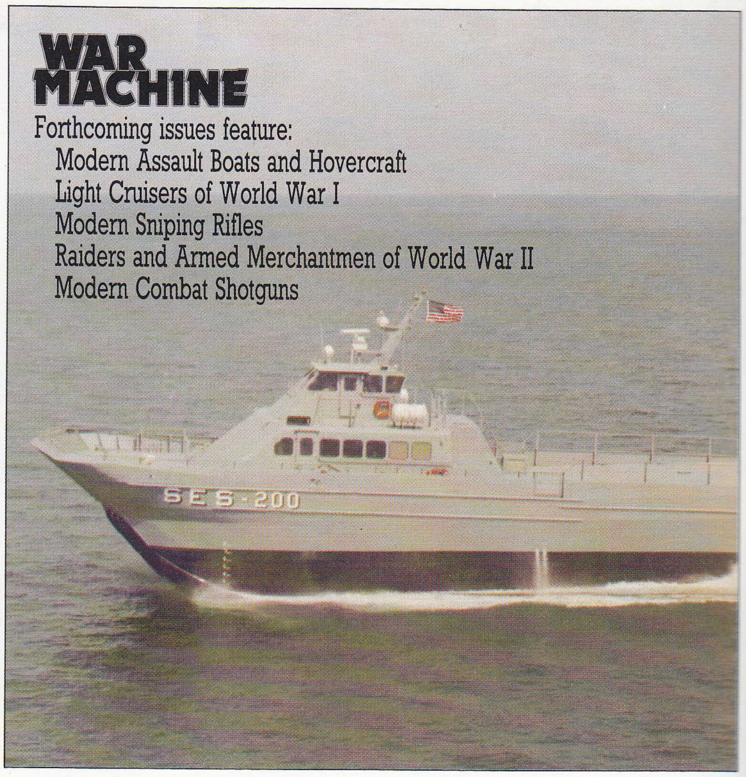

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Cover photograph: Imperial War Museum. **2641:** Imperial War Museum. **2642:** Imperial War Museum/IPC Business Press. **2645:** Imperial War Museum. **2646:** Imperial War Museum/Royal Air Force Museum, Hendon. **2647:** Imperial War Museum. **2648:** US Air Force. **2649:** US Air Force. **2655:** Imperial War Museum. **2656:** US Air Force/P.H.T. Green Collection. **2658:** US Air Force. **2660:** Royal Air Force Museum, Hendon. **(iii):** Finnish MoD/Finnish MoD. **(iv):** Finnish MoD/Finnish MoD.

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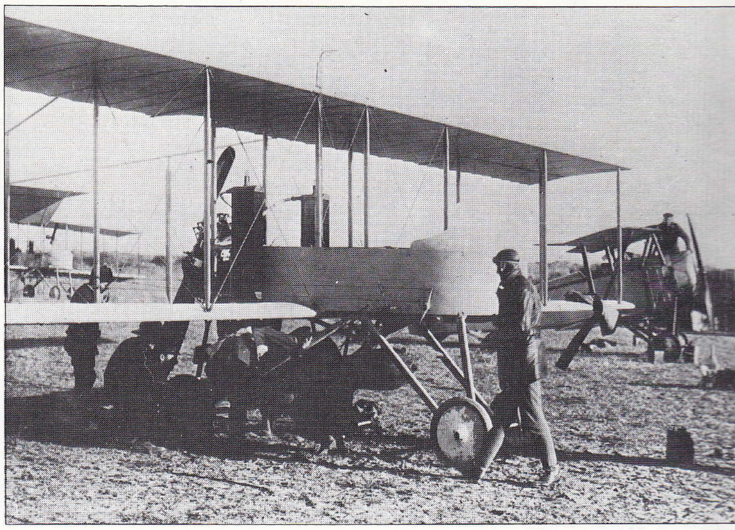
Bombers of World War 1

Nowhere is the technological impetus provided by war more evident than in aviation. At the start of World War I, aircraft looked as if a boy could tie some string to them and fly them in a breeze, but in four short years the fighting aeroplane was appearing in such diverse forms as the single-seat ground attack fighter and the multi-engined, long-range heavy bomber.



Typical of the first-generation bombers evolved during the early years of war, the Voisin Type VIII and IX two-seat bombers formed the backbone of the French night bombing force. Maximum bombload was 300 kg (660 lb).

The use of the aeroplane to deliver fire and explosive against an enemy on the ground was inevitable from the moment the Wright brothers first achieved controlled flight in 1903. What remained in doubt was the degree and accuracy with which it could be delivered. At the beginning of World War I in the West aerial bombs were confined to nothing bigger than hand grenades as the Russians, who alone possessed large aircraft, started lifting bombs of more than about 68 kg (150 lb) and quickly went on to produce weapons of twice that size, weapons that were obviously able to cause as much damage as a large artillery shell, but capable of delivery over a much greater range.

The regular use of the large high explosive bomb in the West came about through the Germans' employment of airships, whose raids on British and French towns and cities were sanctioned by the Kaiser only in return for assurances by the Imperial Naval Staff that military targets alone would be hit. Inevitably, in the absence of any bomb-aiming equipment, civilian casualties resulted so that any such assurances became purely academic. Within two years bombs of 300 kg (661 lb) were landing among the humble homes of the British and French capitals and elsewhere. Thus arrived total war.

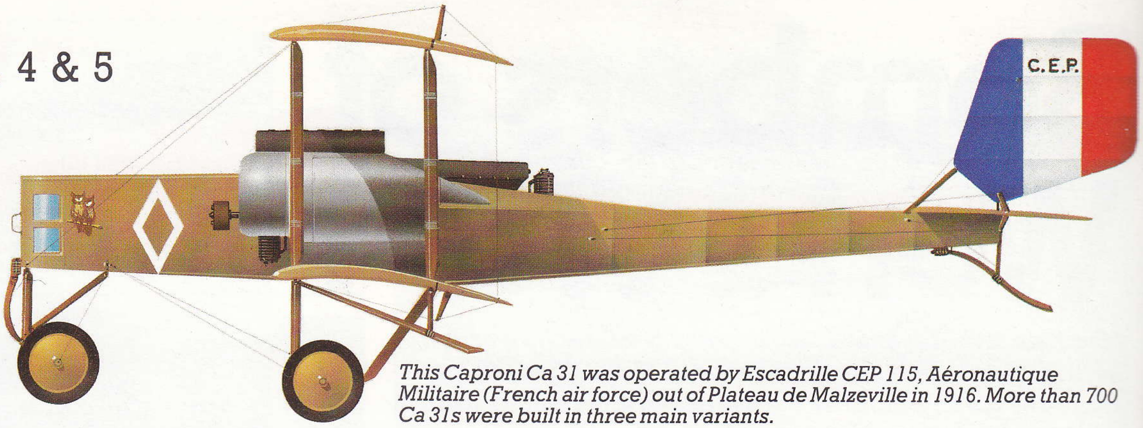
Gradually, however, the value of the airship (progressively shown to be increasingly vulnerable to attack by fighters firing incendiary ammunition) was seen to be of little military significance while at the same time it squandered manufacturing and operating manpower so that, after 1916, it began to take second place to the aeroplane as a bomber. Apart from the Russians, both the Germans and British (as well as the French and Italians to a lesser extent) pursued the development of large bombers, although only the former, with their huge *Riesen* (giants) managed to get a truly heavy bomber (able to lift a 1000-kg/2,205-lb bomb) into operational service during the war. Yet it was the British who first created a strategic bomber force, the Independent Force under Major General Sir Hugh Trenchard, an element of the RAF that was to dominate British Air Staff philosophies for 50 years.

At the other end of the scale much smaller bomb-carrying aircraft were increasingly used over the front lines in France, Italy, Macedonia and the Middle East against such targets as would otherwise be shelled by artillery. One of the lessons learned was that dropping bombs accurately on anything but sizeable, stationary targets was extremely difficult, especially if the target was shooting back. Towards the end of the war, therefore, as the fighting on the various fronts became more fluid and the soldiers left the sanctuary of their trenches, the machine-gun became the favoured weapon of the ground support aeroplane.

By the end of the war, the Royal Air Force had had more than 400 Handley Page O/400 bombers delivered, with raids of up to 40 aircraft at a time being made on industrial centres in Germany. The O/400 also carried the 750-kg (1,650-lb) bomb, the largest such weapon used by British forces at that time.

ITALY

Caproni Ca.3, 4 & 5



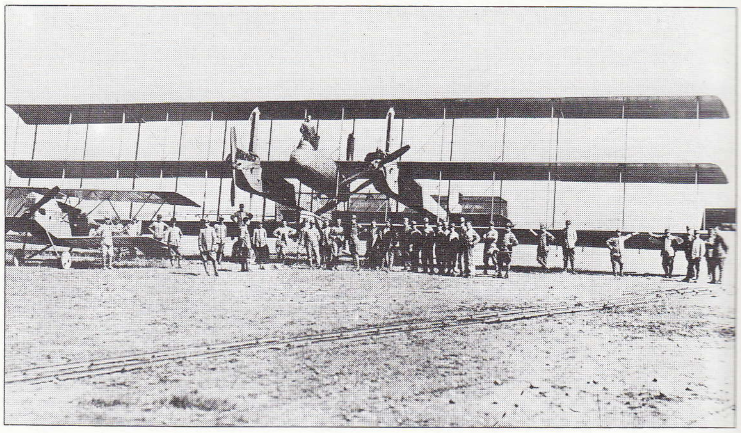
This Caproni Ca 31 was operated by Escadrille CEP 115, Aéronautique Militaire (French air force) out of Plateau de Malzeville in 1916. More than 700 Ca 31s were built in three main variants.

The prototype **Caproni Ca 30** which first flew in October 1914 was a three-engined bomber with a central crew nacelle and twin booms to carry a triple-ruddered tail unit. The powerplant comprised a central engine mounted at the rear of the nacelle (a 100-hp/75-kW Gnome driving a pusher propeller) plus two wing-mounted 80-hp (60-kW) Gnomes each driving a tractor propeller. The definitive model was put into production as the **Ca.3**, and the initial order was for 12 aircraft, although a further 150 were manufactured subsequently.

In 1918 there appeared the **Caproni Ca.4**, a large triplane bomber with the same three-engined nacelle and twin-boom layout of the Ca.3. All but the first three production Ca.4s incorporated a streamlined nacelle, with a gunner's cockpit in the nose, and the early **Ca 41** examples were powered by 300-hp (224-kW) Fiat A.12 or Isotta-Fraschini V.5 engines. Twenty-three aircraft were fitted with 400-hp (298-kW) Liberty engines as the **Ca 42** and six were supplied to the Royal Naval Air Service.

The **Caproni Ca.5** was developed to supersede the Ca.3. The prototype was flown in 1917 and 659 production examples were built between 1917 and 1921, powered by 250-hp (186-kW) Fiat A.12 or Isotta-Fraschini engines, or by the 350-hp (261-kW) Liberty. The type was also selected for manufacture in the United States. However, when the Armistice ended World War I, production plans for 1,500 aircraft were cancelled after just three had been completed. Nevertheless, the US Army Air Corps' Northern Bombing Group used the Ca.5 over the Western Front, as did the Italians and the French.

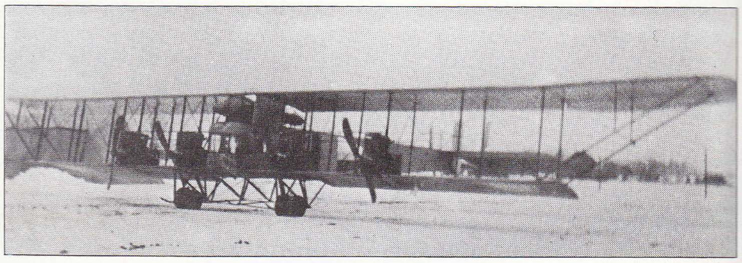
Specification
Ca.5 (Ca 44)
Type: heavy bomber
Powerplant: three 250-hp (186-kW) Fiat A.12 piston engines
Performance: maximum speed 150 km/h (93 mph); service ceiling 4600 m (15,090 ft); range 600 km (373 miles)
Weights: empty 3300 kg (7,275 lb); maximum take-off 5300 kg (11,684 lb)
Dimensions: span 23.40 m (76 ft 9.25 in); length 12.60 m (41 ft 4.25 in); height 4.48 m (14 ft 8.33 in); wing area 150.00 m^2 (1,614.64 sq ft)
Armament: two 7.7-mm (0.303-in) Revelli machine-guns, plus a bombload of 900 kg (1,984 lb)



The Caproni Ca 41 was essentially similar to the Ca 40, but had no nose landing wheels and had a tandem seating arrangement for the two pilots. The unusual bomb arrangement on the sides of the bottom wing nacelle is well displayed, as is the considerable size.

RUSSIA

Sikorsky early aircraft

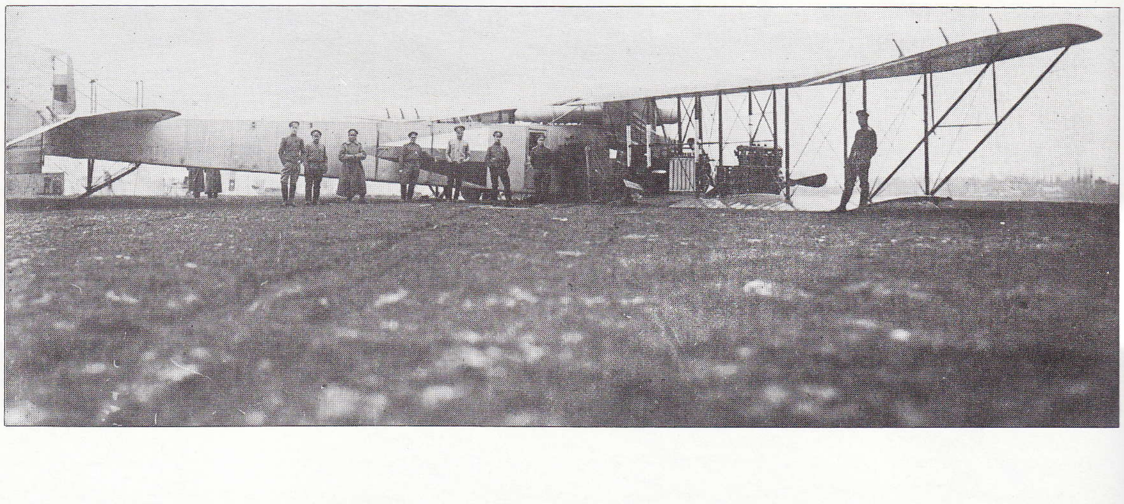


The Sikorsky Ilya Muromets, seen in 1914, was a far cry from the Blériots, Farmans, Taubes and BEs that went to war a year later in the West. The aircraft was without parallel at the time, and the first production model proved capable of flying 16 people.

Following his first unsuccessful experiments with rotary-wing aircraft in 1909-10, the Russian Igor Sikorsky concentrated upon design and development of fixed-wing aircraft. His **Sikorsky S-1** to **S-5** were little more than experimental types, but with the S-2 biplane he achieved a first 12-second hop in 1910. Growing experience and capability gained him an appointment in 1912 as a designer and chief engineer of the Russo-Baltic Wagon Works (RBVZ) and he at once became involved in design and construction of the world's first four-engined aircraft, named officially **Russkii Vitiaz** (Russian knight). This formed a basis for development of the **Ilya Muromets** series of four-engine heavy bombers used by the Imperial Russian army during World War I. The first of between 70 and 80 of these aircraft was flown for the first time in January 1914, and on 12 February 1914 the type established a world height-with-payload record, carrying 16 persons to an altitude of 2000 m (6,562 ft). Few of these production aircraft were identical, improvement and development being continuous, and shortage of engines meant they were flown with a variety of powerplant which, in some cases, involved a mix of engines on one aircraft.

Other designs to enter production during the war period included the **S-16**, a conventional two-seat reconnaissance biplane which, powered by an 80-hp (60-kW) Gnome rotary engine, could be operated on wheel or ski landing gear. The **S-20** which entered service in 1917 was a single-seat scout powered by a 110-hp (82-kW) Le Rhône rotary; it was Sikorsky's last design in Russia, for with advent of the revolution in 1917 he emigrated to the USA.

Specification
Sikorky Ilya Muromets B
Type: heavy bomber
Powerplant: four 150-hp (112-kW) Salmson piston engines
Performance: maximum speed 100 km/h (62 mph); service ceiling not known; range 420 km (260 miles)
Weights: empty 3600 kg (7,936 lb); maximum take-off 4850 kg (10,692 lb)
Dimensions: span 34.5 m (113 ft 2.25 in); length 19.0 m (62 ft 4 in); wing area 150.0 m^2 (1,614.6 sq ft)
Armament: typically 10 16-kg (36-lb) bombs plus a variable defensive armament



Over 80 Ilya Muromets were built, used against German targets on the Eastern Front. They first saw action on the night of 15 February 1915, and were able to operate with relative impunity (although with limited accuracy).

Ground Attack in 1918

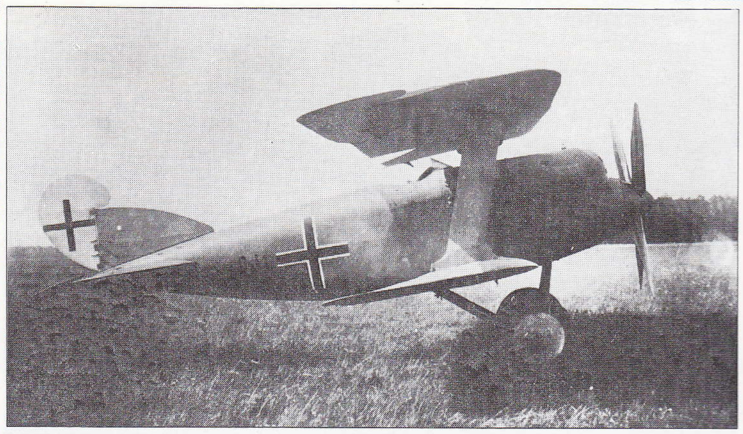
The massive strides taken by aviation in the four years of World War I were nowhere more eloquently demonstrated than in the titanic battles of 1918. Tactical air power, at last making a significant contribution to the struggle, had matured into an indispensible tool for the prosecution of modern war.

The use of aircraft to attack targets (troops, transport and artillery batteries) in the front line increased steadily from the occasional opportunist forays of 1915 to the full-scale offensive actions by swarms of aircraft towards the end of the war. Moreover as early as 1916 aircraft, which today would be classified as tactical support aircraft, were being conceived to attack battlefield targets, atlthough by and large these were 'general-purpose' aircraft capable of dropping light bombs on targets of opportunity while they went about other duties, such as gunnery observation and reconnaissance. It was not until 1918 that the 'trench fighter' (a dedicated gun-armed ground-attack fighter) came to be recognized as a weapon in its own right.

Ironically one of the best of Allied aircraft in the tactical support category was brought into service as early as January 1917, was extremely popular with its crews, and continued to give excellent service right up to the Armistice; yet this aeroplane, the Armstrong Whitworth F.K.8 (the 'Big Ack') never attracted the fame of other World War I aircraft. Despite its size the Big Ack was simple to fly, manoeuvrable, strong and capable of withstanding a great deal of damage from ground small arms fire. By early 1918 the manufacturers were producing the type at the rate of four every day.

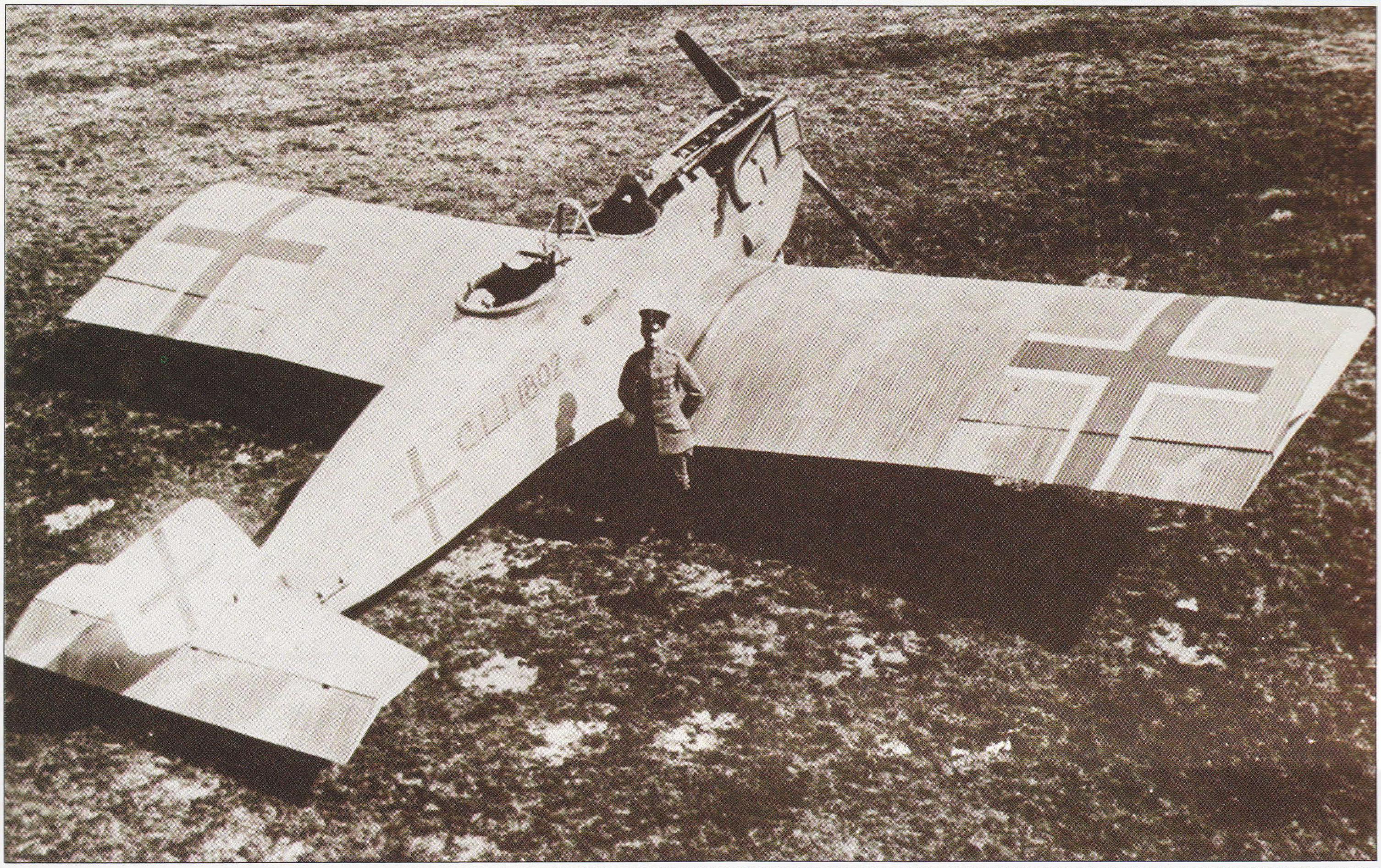
To illustrate the type of work undertaken by the 'Big Acks' in 1918, as well as the hazards faced, it is worth recording that two of the most outstanding awards of the Victoria Cross were made to pilots of this type. A No. 2 Squadron F.K.8, flown by the 18-year-old Lieutenant Alan McLeod with Lieutenant A.W. Hammond, MC, as his observer, was returning from a bombing attack on enemy forces during the great German offensive of March 1918 when it was attacked by Fokker Dr I triplane. This was shot down by Hammond, but almost immediately seven more Fokkers set on the Big Ack. McLeod shot down one of these with his front gun and Hammond two others, although both British crew members were wounded, the latter six times. The rear cockpit floor fell out and the fuel tank was hit and set on fire. Despite being wounded five more times, McLeod climbed out on to the port wing and with one hand gripping the burning control column managed to crashland the blazing aircraft in no-man's land, Hammond continuing to fire his Lewis gun until the crash knocked him unconscious. German aircraft then started to bomb the wreck, again wounding McLeod, as British troops began dragging the airmen towards their lines. Both men miraculously survived, Hammond, one of whose legs had to be amputated, receiving a bar to his MC, and McLeod the VC.

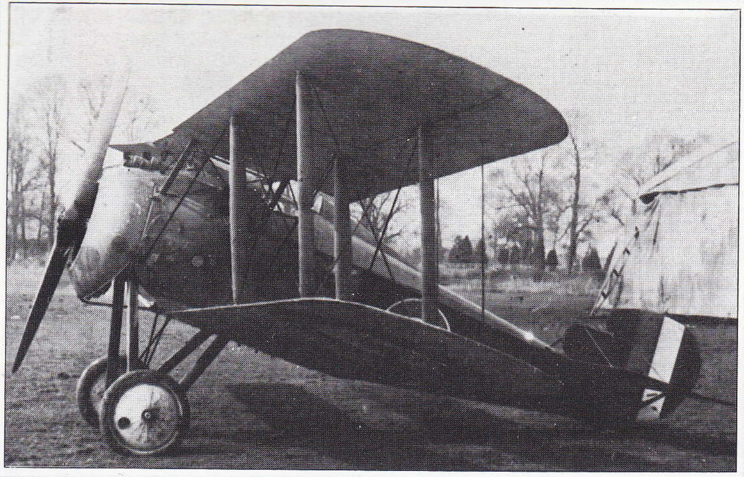
The other award of the VC to a Big Ack pilot was made to Captain F.M.F West of No. 8 Squadron who, with Lieutenant J.A.G. Haslam, on 10 August 1918 had just dropped his 51-kg (112-lb) bombs on a German gun position when he was attacked by six enemy scouts while still flying very low over the trenches. Their first burst of fire almost severed West's left leg and wounded him in the right leg yet, faint from loss of blood and half-dead from pain, he managed to hold the F.K.8 level while Haslam drove off their attackers. West succeeded in landing safely in the British lines but refused to be taken to hospital until he had given a detailed report of German gun dispositions to the tank commander with whom No. 8 Squadron was working.



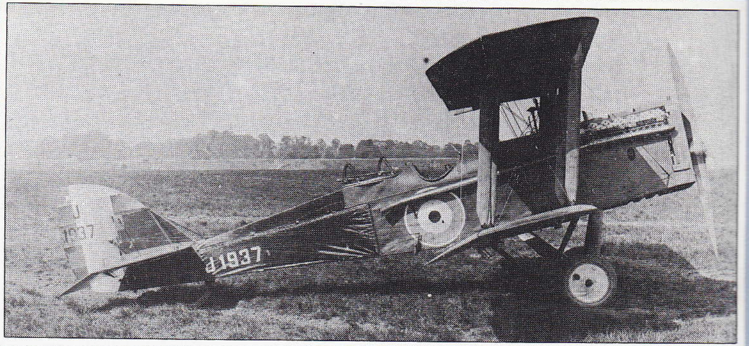
The AEG DJ 1 was a single-seat armoured ground attack fighter roughly equivalent to the Sopwith Salamander. First flying in September 1918, its fuselage was skinned with aluminium and it had a 195-hp engine; the armistice intervened before it could be developed further.

The Junkers CL II was an enlarged version of the J 7 which also formed the basis for the D I monoplane fighter. The Junkers series of dedicated ground-attack aircraft, fitted with armour protection for engines, crew and fuel tanks, could have been the Sturmoviks of the Great War.



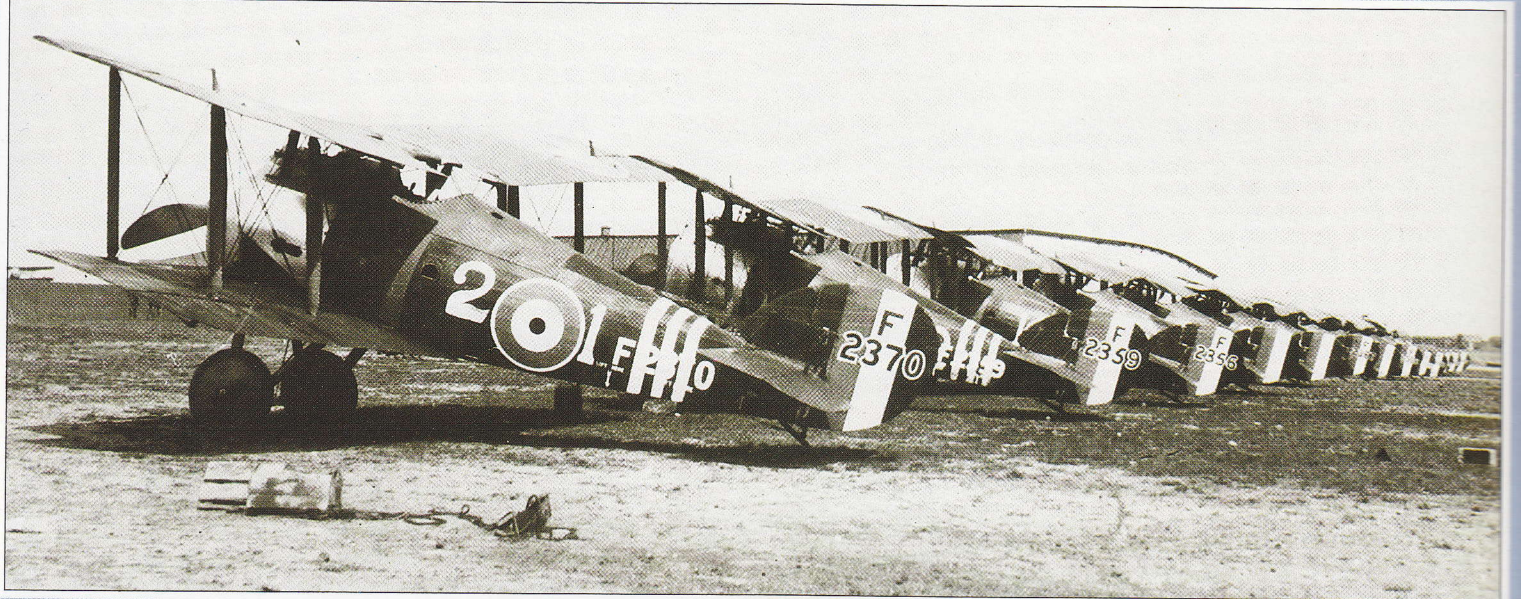


Above: *The Sopwith Salamander was the British answer to the hazards of flying and fighting over the machine-gun laden battlefields of 1918. Heavily armed and armoured, it was the classic British 'Trench Fighter'.*



Above: A Liberty-engined D.H.9A is typical of the much-improved aircraft that were to see service against German airfields in the last months of the war. The 'Nine-Ack' also went into US service with the Marine Corps Northern Bombing Group in the weeks before the Armistice.

Below: By 1918, with one of the major tasks assigned to air power being the support of ground forces, many aircraft found themselves trench-bombing and column-strafing. The Sopwith Snipe, an improved version of the Camel, was typical of the scouts co-opted into the task.



Indeed the work being done at this time by No. 8 Squadron foreshadowed the cab-rank tactics by Hawker Typhoons and Supermarine Spitfires during the last two years of World War II. In 1918 the squadron was attached to the Tank Corps, the observers' cockpits often being occupied by tank crew members as the RAF observers travelled in the tanks; early experiments using rudimentary radio telephone for communication soon gave place to wireless telegraphy, but techniques were still being evolved at the time of the Armistice. Another use of F.K.8s, this time of No. 35 Squadron, involved the dropping of 18-kg (40-lb) phosphorus bombs to generate smoke screens. During the attack by the British XIII Corps west of Serain on 8 October 1918 a two-hour screen was maintained by relays of aircraft to conceal the build-up of the attacking forces. F.K.8s were also used to excellent effect in Macedonia, the aircraft (including some D.H.9s) of No. 47 Squadron dropping 2270 kg (5,000 lb) of bombs on the retreating Bulgarian army in the Kosturino Pass on 21 September 1918. On the same day Bristol F.2B Fighters of No. 1 Australian Squadron took very heavy toll of Turkish troops retreating through a valley in Palestine.

Similar German development

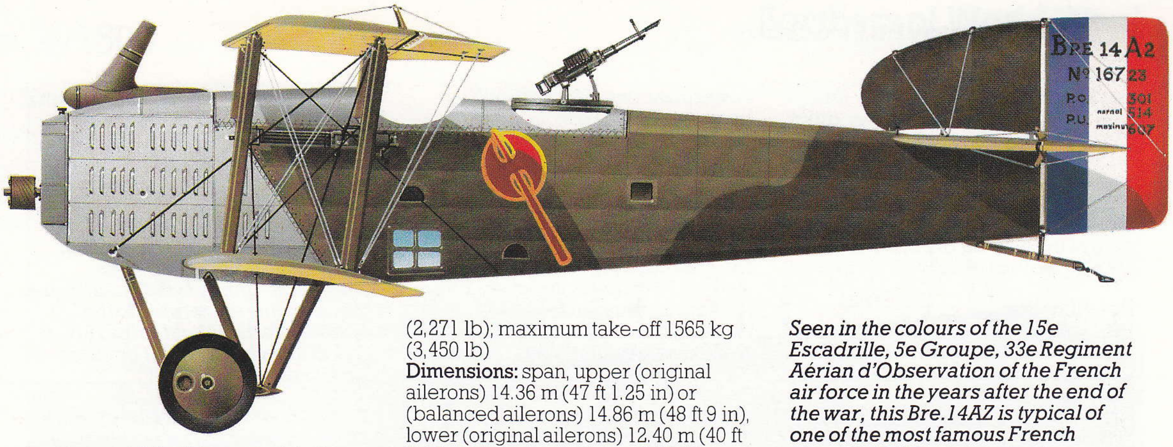
German ground-support aircraft followed much the same development pattern as that of British and French aircraft, although their use of bombs tended to give way to guns and grenades. Among the aircraft which commanded the greatest respect among Allied scout pilots were the Halberstadt CL II and CL III, the former being used in close co-ordination with advancing infantry formations during the battles on the Western Front from the late summer of 1917 onwards. So successful were these air support operations during the German counteroffensive of 30 November in the Battle of Cambrai that a subsequent British court of inquiry stated that German aircraft flying below 30 m (100 ft) and firing their machine-guns into the front-line trenches had had a devastating effect on the morale of the defenders, who seemed unable to hit back with the small arms at their disposal. In the German attacks on the Somme bridges of September 1917 the Halberstadts had caused widespread panic on the ground, many of the troops leaping off the bridge parapets to escape the deluge of fire from above. For such attacks the CL II carried trays of grenades along the outside of the fuselage, the weapons being lobbed overboard at targets of opportunity.

During the last great German 'push' of March 1918 there were no fewer than 38 *Schlachtstaffeln* (battle squadrons), most of which flew Halberstadt CL IIs and CL IVs. These were also employed in an offensive role, flying in groups of about six to strafe enemy trenches and artillery so as to keep opposing troops' heads down at the moment of attack by the German infantry. Until the final months of the war, however, the Germans made much greater use of aircraft machine-guns than the Allies. When warfare became so much more fluid in those final months as the great breakthrough was achieved and the German armies forsook the shelter of their trenches to begin their headlong retreat, British and French scouts (the Sopwith Camels and Snipes, the RAF S.E.5As, the Spads and the Nieuports) dropped down to low level to deliver their own deluge of machine-gun fire on the unprotected columns of troops and horse-drawn transport. Air combats over the routed German armies were commonplace and casualties on both sides were heavy but, as German and Allied pilots were to discover, air combat at low level was exceedingly dangerous and difficult, and it was the Allied superiority of numbers that finally overwhelmed the German air force. Indeed aircraft like the Halberstadts, excellent though they were in support of an infantry attack, were far less effective when forced to defend themselves against the Allied scouts. Nevertheless it was in the offensive tactics formerly flown by those Halberstadts that the seeds of Blitzkrieg were sown: the tight integration of air and ground forces to achieve breakthrough on the battlefield. When, 15 years later a new German air force was born, the Luftwaffe's primary function would be to support the German army on the ground.

By contrast the British, who were hard at work at the end of the war developing the 'trench fighter', such as the Sopwith Salamander (with a battery of forward-firing guns) and Buffalo, dropped the entire concept of high-performance close-support aircraft and reverted to the light bomber. Just 22 years later the wreckage of scores of Fairey Battles in Belgian and French fields lent stark testimony to folly of such a foolish policy.

FRANCE

Breguet 14



Seen in the colours of the 15e Escadrille, 5e Groupe, 33e Regiment Aérian d'Observation of the French air force in the years after the end of the war, this Bre.14AZ is typical of one of the most famous French aircraft of all time, serving in a multitude of roles until 1932.

The **Breguet 14** two-seat tractor biplane began life on the drawing boards at the company's Vélizy-Villacoublay works in the summer of 1916. It remained in production from March 1917 to 1928, and was not withdrawn from service with France's Aéronautique Militaire until 1932.

Although rather ugly, the Bre.14 was immensely practical and tough. Its angular fabric-covered wings and fuselage were of duralumin, steel and wooden construction, with ailerons on both upper and lower wings. Sturdy cross-axle landing gear was fitted and the Renault engine, which had a rectangular frontal radiator, performed well.

The **Bre.14 A.2** reconnaissance version was equipped with camera, wireless transmitter and racks for four light bombs. It was the first version to make its mark, beginning to replace the obsolescent Sopwith 1½-Strutter during the summer of 1917. The type was issued to a number of well-known reconnaissance *escadrilles*, including the 11e, 35e and 227e, as well as many *escadrilles* attached to heavy artillery regiments of the French army. **Bre.14 B.2** bombers made many impressive formation daylight raids deep behind the German lines. When the November 1918 armistice brought hostilities to an end, Breguet 14 B.2s equipped the 15 *escadrilles* of the 1e brigade de Bombardement, while Bre.14 A.2s were flying with 12 day-reconnaissance *escadrilles* and the 19 *escadrilles* of the Aviation des Corps d'Armées. The five independent army divisions each had a Bre.14 A.2 *escadrille*. A total of 27 Bre.14 A.2 *escadrilles* was attached to heavy artillery regiments.

Other wartime verisons of the type included the **Bre.14 B.1** single-seat bomber, which did not go into large-scale production, and the **Bre.14S** ambulance. A Breguet 14 had been used experimentally for rapid evacuation of casualties from just behind the front line in 1917. In 1918 four Bre.14S ambulances, each carrying two stretcher cases, operated on the Aisne front.

The Breguet 14 served with 14 *escadrilles* in Greece, Serbia and the Middle East at the end of 1918, but it was in the French overseas empire that it was to achieve great distinction over more than a decade in the period between the two world wars. The version utilized in the more far-flung colonies was the **Breguet 14 TOE** (Théatre des Operations Extérieures).

Specification

Breguet 14 A.2

Type: two-seat reconnaissance aircraft

Powerplant: one 300-hp (224-kW) Renault 12Fe inline piston engine

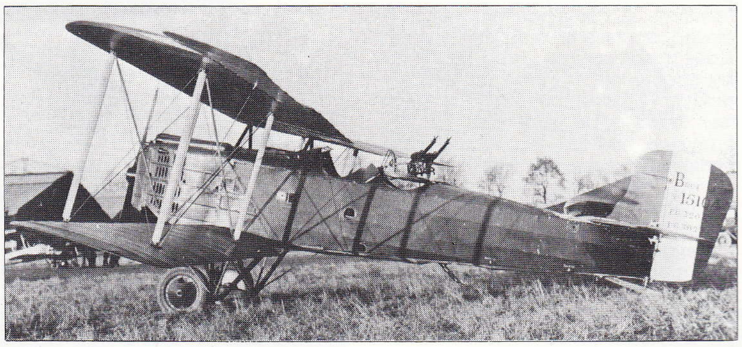
Performance: maximum speed 184 km/h (114 mph); service ceiling 6000 m (19,690 ft); endurance 3 hours

Weights: empty equipped 1030 kg (2,271 lb); maximum take-off 1565 kg (3,450 lb)

Dimensions: span, upper (original ailerons) 14.36 m (47 ft 1.25 in) or (balanced ailerons) 14.86 m (48 ft 9 in), lower (original ailerons) 12.40 m (40 ft 8 in) or (balanced ailerons) 13.66 m (44 ft 9.75 in); length 8.87 m (29 ft 1¼ in); height 3.30 m (10 ft 10 in); wing area (original ailerons) 47.50 m^2 (511.30 sq ft) or (balanced ailerons 49.20 m^2 (529.60 sq ft)

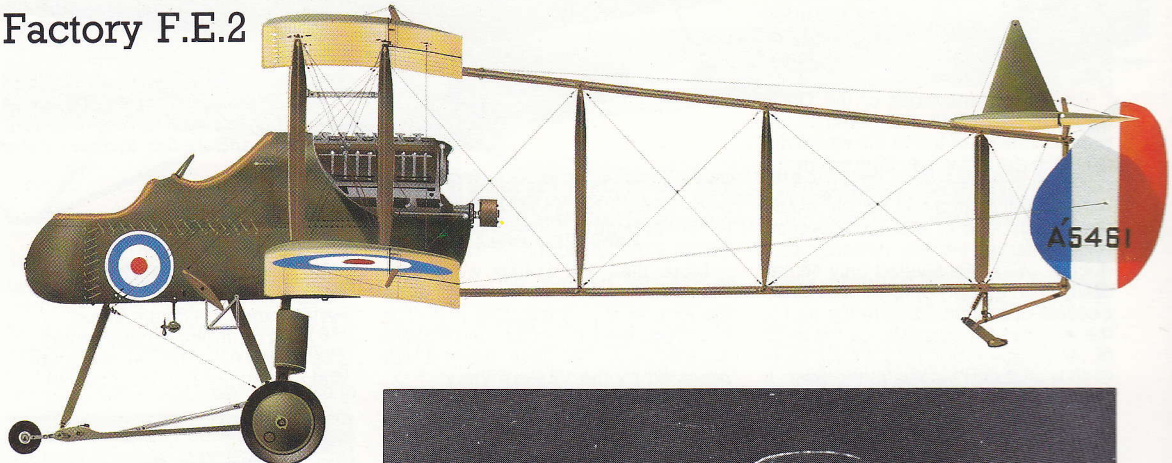
Armament: one fixed 7.7 mm (0.303-in) Vickers machine-gun on port side of fuselage and twin 7.7-mm (0.303-in) Lewis machine-guns on ring mounting in observer's cockpit, plus bombload up to 40 kg (88 lb)

Flown in the summer of 1918, the Breguet 17 was an excellent development of the Bre.14 airframe, being more compact and with an uprated engine. The gunner had two conventionally-mounted Lewis guns, and one beneath his cockpit.



UK

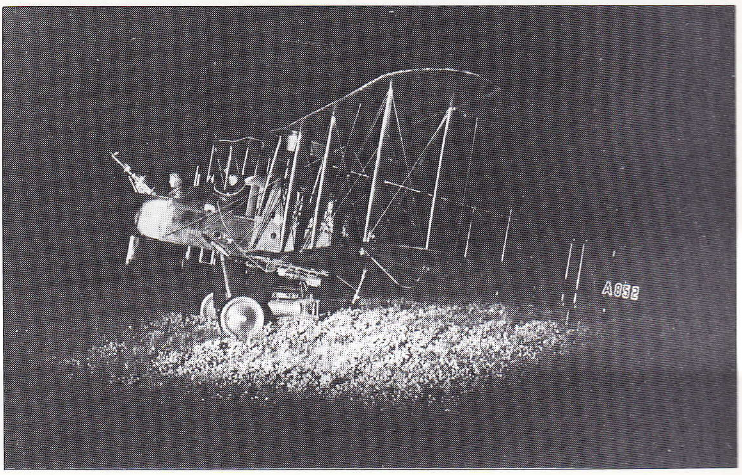
Royal Aircraft Factory F.E.2



Above: A Royal Aircraft Factory F.E.2b of No. 22 Sqn, Royal Flying Corps, based in France in 1917. Operating from a number of airfields in the army co-operation role, the squadron took part in the major offensives of the spring of that year before converting to F.2B fighters.

The **Royal Aircraft Factory F.E.2** represented an initial solution to the problem of providing effective forward-firing capability before the introduction of interrupter gear. It had a two-seat fuselage nacelle in which the powerplant was mounted at the rear to drive a pusher propeller. The pilot had the rear position and the forward cockpit was occupied by the observer/gunner. Initial version was the **F.E.2a**, powered by a 100-hp (75-kW) Green engine, but disappointing performance resulted in the 120-hp (89-kW) Beardmore engine being installed in the **F.E.2b**, which was entering service in small numbers towards the end of 1915. Two **F.E.2c** aircraft were produced by the Factory, these having the pilot seated forward and observer to the rear for a night flying role. The designation **F.E.2d** applied to a version with similar airframe, but a 250-hp (186-kW) Rolls-Royce engine, this provided considerably improved performance.

In operational service the F.E.2b, working in collaboration with the Airco (de Havilland) D.H.2, gradually restricted the menace of the Fokker monoplane, but was in turn to meet its match when confronted by the more advanced Albatros and Halberstadt scouts that began to equip the German air service in late 1916. However, the suitability of the F.E.2b for night flying meant that it was to be deployed for



This is thought to be an F.E.2b of No. 25 Sqn preparing for a night raid in 1916, a role which became ever more important to an aircraft vulnerable to each new generation of fighting scouts.

Royal Aircraft Factory F.E.2 (continued)

night bombing operations in Europe and for home defence against dirigibles and Gotha bombers, remaining occupied in these roles until the final year of World War I. Production of F.E.2a/F.E.2b aircraft totalled 1,939, and although there is no accurate record of the number of F.E.2d aircraft, it is believed that about 250 were built.

Specification
RAF F.E.2b
Type: two-seat fighter
Powerplant: one 120-hp (89-kW) Beardmore inline piston engine
Performance: maximum speed 129 km/h (80 mph) at sea level; service ceiling 2745 m (9,000 ft); endurance 3 hours
Weights: empty 904 kg (1,993 lb); maximum take-off 1347 kg (2,970 lb)
Dimensions: span 14.55 m (47 ft 9 in); length 9.83 m (32 ft 3 in); height 3.85 m (12 ft 7.5 in); wing area 45.89 m^2 (494.0 sq ft)
Armament: initially a single 7.7-mm (0.303-in) Lewis gun, but later a second Lewis gun was added; in a bomber role a maximum of 159 kg (350 lb) of bombs could be carried in various combinations

Introduced in late 1915 to deal with the 'Fokker Scourge', the F.E.2 (in collaboration with the D.H.2) gradually gained an ascendancy, but soon became vulnerable to the Albatros and Halberstadt of 1916. It ended the war as a night bomber.

UK

Handley Page O/100 and O/400

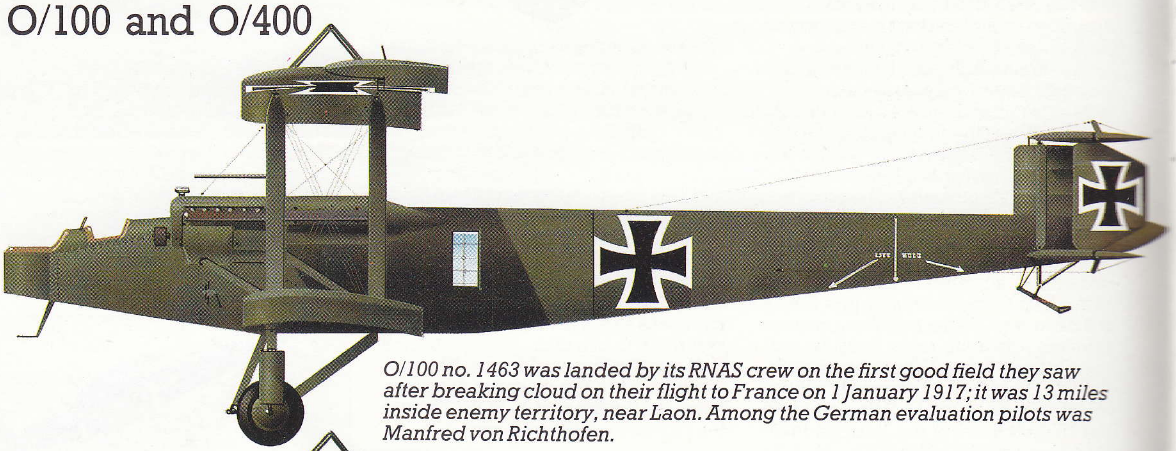
To meet an Admiralty specification of December 1914 for a large twin-engine patrol bomber, Handley Page lost little time in designing an aircraft to meet this requirement and when the **Handley Page O/100** prototype was completed, it was the largest aeroplane that had been built in the UK.

The O/100 was powered by two 266-hp (198-kW) Rolls-Royce Eagle II engines, in armoured nacelles, mounted between the wings just outboard of the fuselage. Accommodation was in a glazed cockpit enclosure, the floor and sides of the cockpit being protected by armour plate. Flown for the first time on 17 December 1915, the O/100 was found to be inadequate in performance, and the second prototype had a revised open cockpit for a crew of two (with provision for a gunner's position forward), the cockpit armour plating and most of that incorporated in the engine nacelles was deleted, and new radiators were introduced for the water-cooled engines.

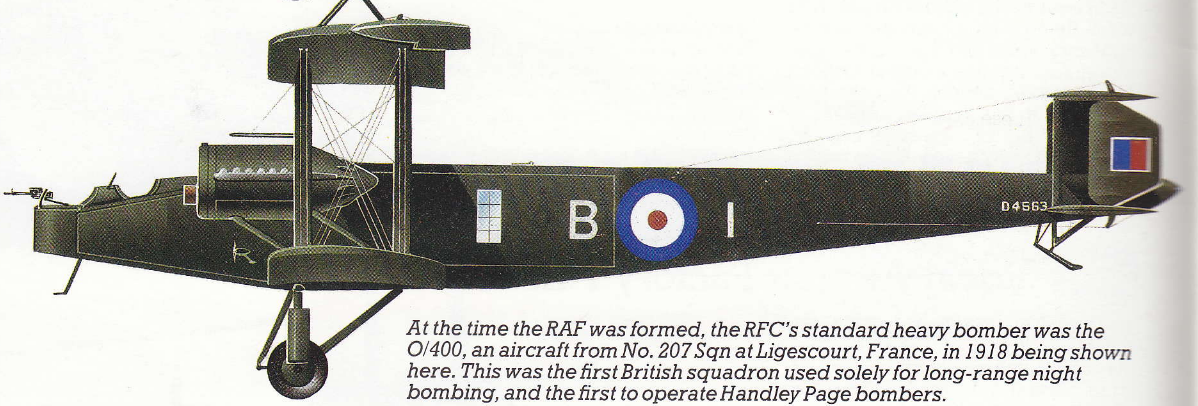
Formation of the first 'Handley Page Squadron', as it was then known, began in Augut 1916 and this unit became operational in France in late October or early November; its first recorded bombing attack was made on the night of 16/17 March 1917 against an enemy-held railway junction.

Production deliveries of the **O/400** began in early 1918, this being an improved version of the O/100 which differed primarily by having more powerful Rolls-Royce Eagle engines, a revised fuel system and radiators, and the introduction of a compressed-air engine starting system. Although production of O/100s totalled only 46 aircraft, substantial numbers of O/400s became operational before the end of the war and, for example, on the night of 14/15 September 1918 a force of 40 O/400s attacked targets in the Saar. It was also at about this same time that these aircraft began to deploy 748-kg (1,650-lb) bombs, the heaviest used by British services during World War I.

More than 400 O/400s were delivered for service with the RAF before the Armistice of November 1918. The type remained in service in reduced numbers until late 1919, when it was replaced by the Vickers Vimy.

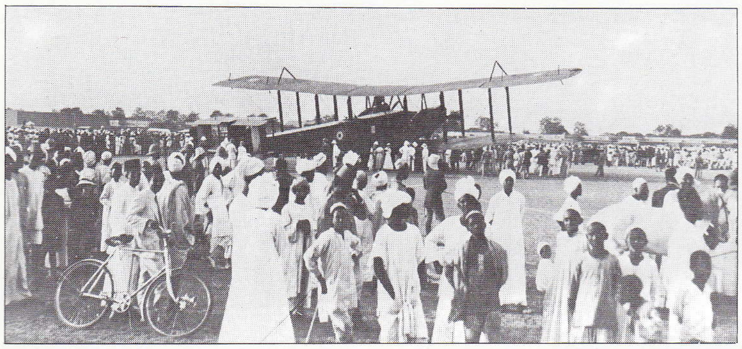


O/100 no. 1463 was landed by its RNAS crew on the first good field they saw after breaking cloud on their flight to France on 1 January 1917; it was 13 miles inside enemy territory, near Laon. Among the German evaluation pilots was Manfred von Richthofen.

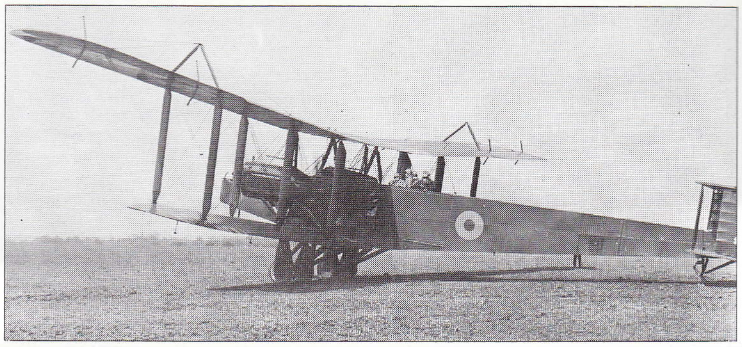


At the time the RAF was formed, the RFC's standard heavy bomber was the O/400, an aircraft from No. 207 Sqn at Ligescourt, France, in 1918 being shown here. This was the first British squadron used solely for long-range night bombing, and the first to operate Handley Page bombers.

Specification
Handley Page O/400
Type: heavy bomber
Powerplant: two 360-hp (268-kW) Rolls-Royce Eagle VIII 12-cylinder Vee piston engines
Performance: maximum speed 156 km/h (97 mph); service ceiling 2590 m (8,500 ft); endurance 8 hours
Weights: empty 3719 kg (8,200 lb); maximum take-off 6350 kg (14,000 lb)
Dimensions: span 30.48 m (100 ft 0 in); length 19.16 m (62 ft 10.25 in); height 6.71 m (22 ft 0 in); wing area 153.10 m^2 (1,648.0 sq ft)
Armament: up to five 7.7-mm (0.303-in) Lewis gun on pivoted mounts, plus a maximum bombload of 907 kg (2,000 lb)



The large fuel capacity of the Handley Page O/400 made it a suitable aircraft to blaze the trail for the Empire flying routes to come. This aircraft was used by Borton, Salmond and Smith to survey the airmail route from Egypt to India, and is seen in Delhi on 12 December 1918.



The O/400 replaced the O/100 in production early in 1918, being powered by a pair of 350-hp (261-kW) Rolls-Royce Eagle engines and having improved fuel systems and radiators. Maximum bombload was of the order of 907 kg (2,000 lb), and the heaviest bomb carried was of 750 kg (1,650 lb).

UK

Handley Page V/1500

Designed and developed to make it possible for the RAF to mount attacks on German targets from bases in the UK, the **Handley Page V/1500** must be regarded as the first practical strategic bomber. Larger in size than the O/100s and O/400s that had preceded it, the V/1500 was powered by four Rolls-Royce engines, these mounted in tandem pairs between the wings, outboard of the fuselage, but was in other respects similar in overall configuration to the earlier bombers.

The prototype, assembled by Handley Page from components manufactured by Harland and Wolff, was flown for the first time during May 1918. This differed primarily from production aircraft by having a single large cooling radiator to serve all four engines, the standard installation becoming one hexagonal radiator forward of each pair of engines. This larger aircraft provided accommodation for a crew of five to seven.

When the armistice was signed only three V/1500s were ready for operational use, these standing by with No. 166 Squadron at Bircham Newton, Norfolk, where they had been frustrated by bad weather from attacking targets in Germany. The type saw only limited post-war service with the RAF, gradually being replaced by the Vickers Vimy. One was used to record the first through flight from England to India: taking off on 13 December 1918, the aircraft flew via Rome, Malta, Cairo, and Baghdad to Karachi, which it reached on 30 December. This aircraft was used in May 1919 to make a bomb attack on Kabul during the problems in Afghanistan. Another V/1500 was shipped to Newfoundland with the object of making a first west-east flight over the North Atlantic, but this project was abandoned when Alcock and Brown achieved the first crossing in a Vickers Vimy. The post-1924 designation was **H.P.15**.

Specification

Handley Page V/1500

Type: long-range heavy bomber

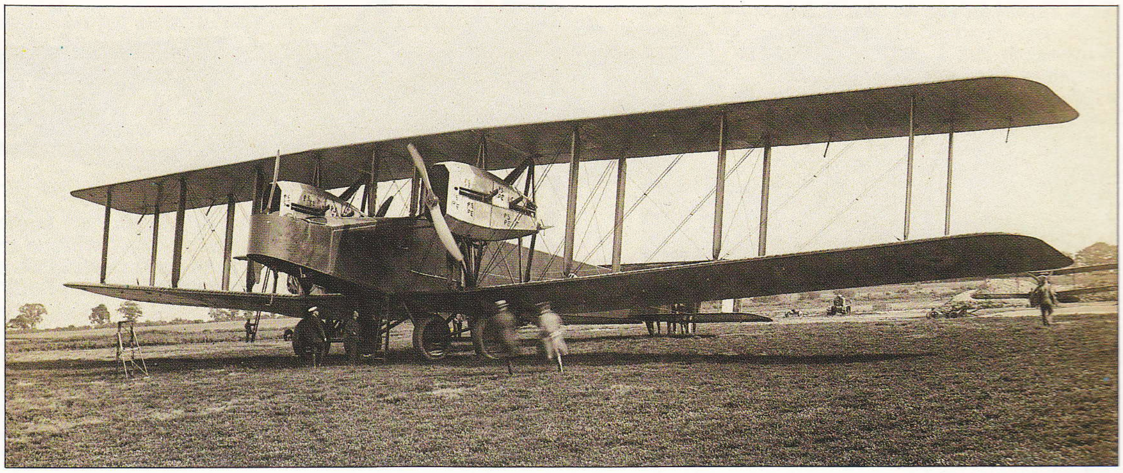
Powerplant: four 375-hp (280-kW) Rolls-Royce Eagle VIII 12-cylinder Vee piston engines

Performance: maximum speed 159 km/h (99 mph) at 1980 m (6,500 ft); service ceiling 3355 m (11,000 ft); range 2092 km (1,300 miles)

Weights: empty 7983 kg (17,600 lb); maximum take-off 13608 kg (30,000 lb)

Dimensions: span 38.40 m (126 ft 0 in); length 19.51 m (64 ft 0 in); height 7.01 m (23 ft 0 in); wing area 278.70 m^2 (3,000.0 sq ft)

Armament: single or twin 7.7-mm (0.303-in) Lewis guns in nose, dorsal, ventral and tail positions, plus up to 3402 kg (7,500 lb) of bombs



The Handley Page V/1500 was too late for World War I and too large for the peacetime Royal Air Force, but had the war lasted until 1919 its 2100-km (1,300-mile) range and massive (for the time) bombload would have made a significant contribution.

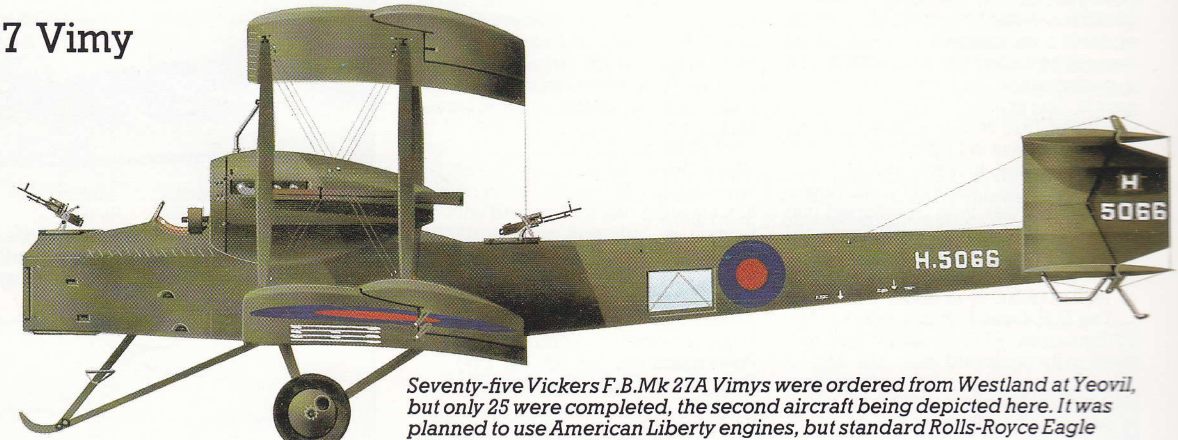
UK

Vickers F.B.27 Vimy

The **Vickers F.B.27 Vimy** bomber prototype was flown for the first time on 30 November 1917; like the de Havilland D.H.10 Amiens and Handley Page V/1500, it was designed to provide the RAF with a strategic bomber that could attack industrial targets in Germany. Although token numbers of each had arrived in France or were with British squadrons before the Armistice of 11 November 1918, none of them saw operational service in World War I. The **F.B.27A Vimy Mk II** was ordered into large-scale production, but contract cancellations at the war's end limited the total built to about 230. It was not until July 1919 that the Vimy was in full RAF service, equipping first No. 58 Squadron in Egypt, then other squadrons in the Middle East and in the UK. It remained in first-line service until replaced by the Vickers Virginia during 1924-5.

The Vimy is, of course, remembered in aviation history for its pioneering flights, including the first nonstop west-east crossing of the North Atlantic by John Alcock and Arthur Whitten Brown; the first England-Australia flight by Ross and Keith Smith and their crew; and the attempted first England-South Africa flight by Pierre van Ryneveld and Christopher Q. Brand, of which the final leg, Bulawayo to Cape Town, was completed in a D.H.9.

Final derivative of the Vimy was the **Vickers Vernon** bomber/transport used by the RAF during its policing of Iraq from 1921. Serving with Nos 45 and 70 Squadrons at Hinaidi, they not only carried out their basic tasks, but were used as air ambulances and played a significant role in establishing the Cairo-Baghdad airmail route.



Seventy-five Vickers F.B.Mk 27A Vimys were ordered from Westland at Yeovil, but only 25 were completed, the second aircraft being depicted here. It was planned to use American Liberty engines, but standard Rolls-Royce Eagle VIIIs were eventually fitted.

Specification

Vickers Vimy Mk II

Type: heavy bomber

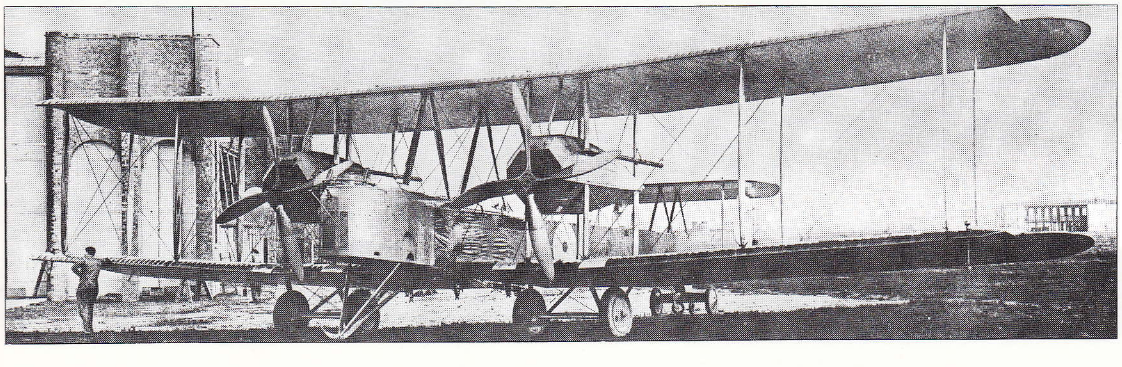
Powerplant: two 360-hp (268-kW) Rolls-Royce Eagle VIII Vee piston engines

Performance: maximum speed 166 km/h (103 mph) at sea level; service ceiling 2135 m (7,000 ft); maximum range 1448 km (900 miles)

Weights: empty 3222 kg (7,104 lb); maximum take-off 4937 kg (10,884 lb)

Dimensions: span 20.75 m (68 ft 1 in); length 13.27 m (43 ft 6.5 in); height 4.76 m (15 ft 7.5 in); wing area 122.44 m^2 (1,318.0 sq ft)

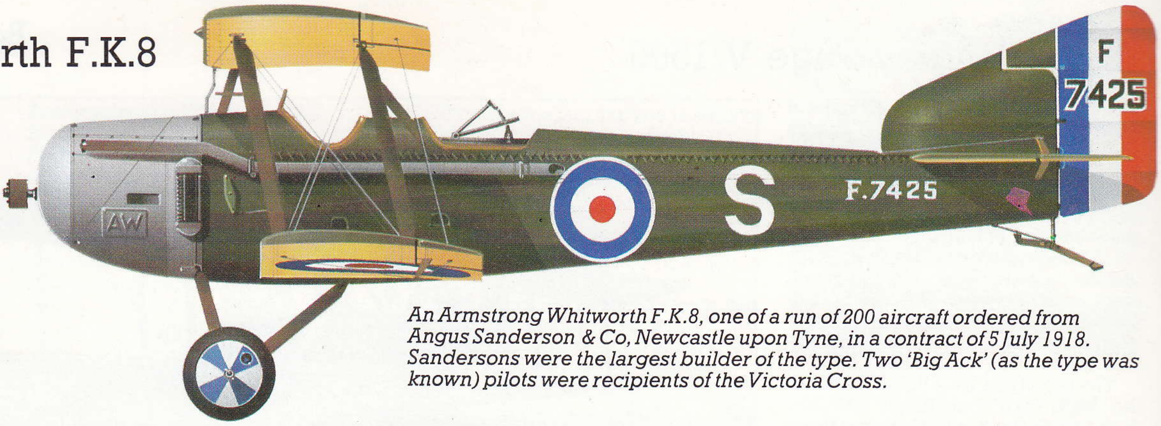
Armament: one 7.7-mm (0.303-in) Lewis machine-gun on a Scarff ring mounting in both nose and mid positions, plus up to 1123 kg (2,476 lb) of bombs on external racks



The Vickers F.B.27 Vimy was designed to provide a heavy bomber for the RFC, but only a single Vimy Mk IV had reached France by October 1918. It went on to prove a mainstay of the RAF's bombing squadrons, and Alcock and Brown flew one across the Atlantic.

UK

Armstrong Whitworth F.K.8



An Armstrong Whitworth F.K.8, one of a run of 200 aircraft ordered from Angus Sanderson & Co, Newcastle upon Tyne, in a contract of 5 July 1918. Sandersons were the largest builder of the type. Two 'Big Ack' (as the type was known) pilots were recipients of the Victoria Cross.

As a replacement for the B.E.2c, Koolhoven designed the **Armstrong Whitworth F.K.8**, an aircraft of altogether more sturdy appearance, with a considerably larger fuselage to cope with the specialist equipment required for the type's army co-operation role. Produced at the same time as the Royal Aircraft Factory's R.E.8, which was intended for the same task, the F.K.8 was generally considerably superior, but no doubt politics were responsible for the much larger orders for the government-establishment machine.

First flown in May 1916, the F.K.8 was sent to the Central Flying School at Upavon for testing where, although its handling was satisfactory, it fell somewhat short of the specified performance. Nevertheless, substantial orders were placed. Armstrong Whitworth received contracts beginning in August 1916 for more than 700, while another 950 were built by Angus Sanderson in Newcastle. Production at the Armstrong Whitworth factory was between 80 and 100 F.K.8s per month by the end of 1917, and this continued until July 1918, when the company received contracts for Bristol Fighter production and handed over F.K.8 responsibility to Sanderson.

The F.K.8 served with several squadrons in France, the first to become fully equipped being No. 35, while other squadrons served overseas.

Specification

Armstrong Whitworth F.K.8

Type: two-seat general-purpose aircraft
Powerplant: one 160-hp (119-kW) Beardmore inline piston engine
Performance: maximum speed 153 km/h (95 mph) at sea level; climb to 1980 m (6,500 ft) in 19 minutes; service ceiling 3960 m (13,000 ft); endurance 3 hours
Weights: empty 869 kg (1,916 lb); maximum take-off 1275 kg (2,811 lb)
Dimensions: span 13.26 m (43 ft 6 in); length 9.58 m (31 ft 5 in); height 3.33 m (10 ft 11 in); wing area 50.17 m^2 (540 sq ft)
Armament: one fixed 7.7-mm (0.303-in) synchronized Vickers machine-gun and one trainable 7.7-mm (0.303-in) Lewis machine-gun in the rear cockpit

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UK

Airco D.H.4, 9 and 9A

A major reason for the Allied victory in the air war against Germany was that the Allies managed to develop more and more powerful aero-engines while the German aircraft had to make do with a limited variety of weaker powerplants. It was an engine, the superlative Rolls-Royce Eagle, which endowed an otherwise conventional two-seater called the **Airco D.H.4** with a performance on a par with enemy scouts. The prototype D.H.4 had flown in August 1916 with a different powerplant but delays in placing this unit into production led to early models carrying a 250-hp (186-kW) Rolls-Royce engine; this was later developed into the mighty 375-hp (280-kW) Eagle VII which enabled the D.H.4 to top 225 km/h (140 mph) in level flight and to climb to 1830 m (6,000 ft) in under 5 minutes.

The D.H.4 was first delivered to No. 55 Squadron, RFC, in early 1917 and eventually equipped nine RAF and 13 American squadrons by the Armistice; it also served with the RNAS. Generally armed with a Vickers machine-gun firing forward and one (sometimes two) Lewis guns in the observer's position, the D.H.4 could carry up to 209 kg (460 lb) of bombs on underwing racks. Machines built by Westland for the RNAS carried twin Vickers guns and the observer's Lewis on a pillar mounting. Two D.H.4s were modified as airship interceptors: each sporting a 1½-lb quick-firer mounted to fire nearly vertically upwards, they anticipated some of the night-fighters of World War II but never saw action.

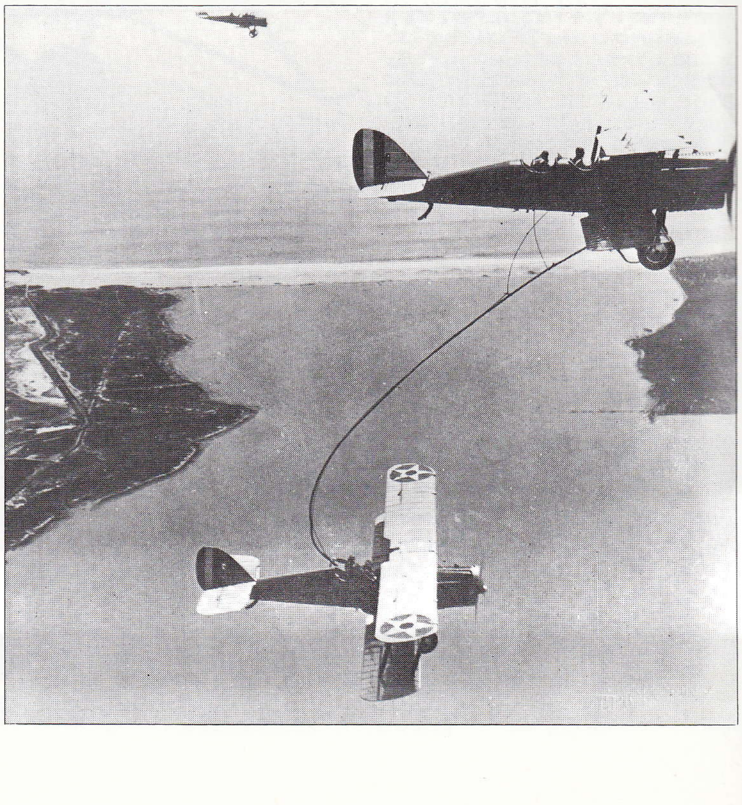
The only flaw in the design of the D.H.4 was the distance separating pilot and observer, which rendered communication almost impossible. Although the layout gave the pilot good downward visibility and the observer a good field of fire, the lack of communication was a serious drawback in air-to-air combat. The **D.H.9** rectified this, placing the crew close together in a newly designed fuselage married to the same wings and tail as the D.H.4. Designed as a long-range bomber in mid-1917, the D.H.9 was heralded as an outstanding aircraft but when the machine appeared on the Western Front in the spring of 1918, its performance fell far short of expectations. Its BHP Puma engine gave endless trouble, and there were not enough Rolls-Royce Eagles to equip the armada of D.H.9s rapidly being assembled. Westland came to the rescue: having manufactured large numbers of D.H.4s and D.H.9s, they redesigned the aircraft to accept the American Liberty engine. The result was the **D.H.9A**, which was a massive improvement and is rightly regarded a one of the best strategic bombers of the 'Great War'. Unlike most of its contemporaries, the D.H.9A continued in production after the war and served with distinction in Iraq and on the troubled North West frontier of India.

Specification

Airco D.H.4

Type: two-seat day bomber
Powerplant: one 375-hp (280-kW) Rolls-Royce Eagle VII inline piston engine
Performance: maximum level speed 230 km/h (143 mph); climb to 1830 m (6,000 ft) in 4 minutes 50 seconds; service ceiling 6705 m (22,000 ft); endurance 3 hours 45 minutes
Weights: empty 1083 kg (2,387 lb); maximum take-off 1575 kg (3,472 lb)
Dimensions: span 12.92 m (42 ft 4.5 in); length 9.35 m (30 ft 8 in); height 3.35 m (11 ft 0 in); wing area 40.32 m^2 (434.0 sq ft)
Armament: one (RFC) or two (RNAS) fixed forward-firing 7.7-mm (0.303 in) Vickers machine-guns and one or two 7.7-mm (0.303 in) Lewis guns in aft cockpit, plus up to 209 kg (460 lb) of bombs on underfuselage/wing racks; American-built DH-4s had two 7.62-mm (0.3-in) Marlin forward-firing machine-guns, but otherwise were as British production

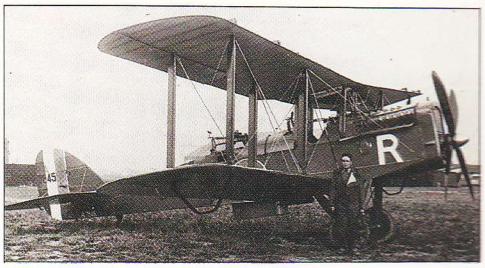
Because of the fuel tank between pilot and observer, the D.H.4 was nicknamed the 'Flaming Coffin' by its crews. Nonetheless, it was built in extremely large numbers, its considerable virtues outweighing that major fault.



The D.H.9A served for many years with the RAF, but unlike its predecessor was only used in small numbers by the US Army. It was used in the 37-hour endurance record set on 27/28 August 1923 by the Americans Smith and Richter.

Airco D.H.4 and D.H.9 in Action

Geoffrey de Havilland always had a flair for producing aircraft that fitted the bill for a specific requirement. In 1916, with World War I in progress, there was a need for an advanced bombing and reconnaissance aircraft which would give the RFC a 'strategic' bombing capability, being able to hit German targets far beyond the trenches. The aircraft that more than met this need was the D.H.4.



The D.H.4 was a revelation to the pilots of the Royal Flying Corps, giving bomber pilots an advantage in performance over the German scouts that had wrought havoc among the pusher squadrons in 1916.

When Geoffrey de Havilland's D.H.4 first reached Royal Flying Corps squadrons early in 1917 it was greeted with enthusiasm as possessing a performance adequate to outdistance then-current German scouts such as the Albatros and Fokker D III, as well as being able to outmanoeuvre (in experienced hands) all such aircraft. As such it earned lasting fame as the first successful high-performance day bomber.

Early aircraft were powered by 250-hp (186-kW) Rolls-Royce engines and these accompanied No. 55 Squadron to France early in March 1917, followed by No. 57 Squadron in May and by No. 25 Squadron two months later. The first-named unit did not enter combat immediately, being ordered to hold its D.H.4s in reserve so as to achieve the greatest possible surprise in the Battle of Arras which opened on 6 April. On that day and on several subsequent occasions No. 55 Squadron attacked Valenciennes railway station as an important German communications centre. Early in May the targets shifted to the rail junctions at Brebières and Bussigny, where a small number of casualties was suffered from ground fire.

During the Battle of Ypres of May 1917 No. 55 Squadron was joined by the D.H.4s of No. 57, the light bombers being able to operate out of reach of German opposition above 4875 m (16,000 ft). In October that year, by which time No. 18 Squadron had become the RFC's fourth D.H.4 squadron in France, No. 55 was withdrawn from the front to become one of the first three units comprising the RFC's 41st Wing (the others being No. 100 Squadron with RAF F.E.2b pushers and No. 16 (Naval) Squadron with Handley Page O/100s). The 41st Wing, later renamed the VIII Brigade, ultimately became the Independent Force of the RAF on 6 June 1918, and as such the main instrument of strategic bombing by the Allies.

Between October 1917 and the end of the war a year later, No. 55 flew repeated bombing raids over western Germany in daylight, the nature of the raids becoming increasingly of a strategic type. Some 94 such attacks were made against munitions factories and other targets in Cologne, Darmstadt, Düren, Frankfurt, Kaiserslautern, Mannheim, Metz-Sablon and Saarbrücken, some of these objectives involving five and a half hour flights which allowed no margin for air combat. These raids cost No. 55 Squadron a total of 69 D.H.4s.

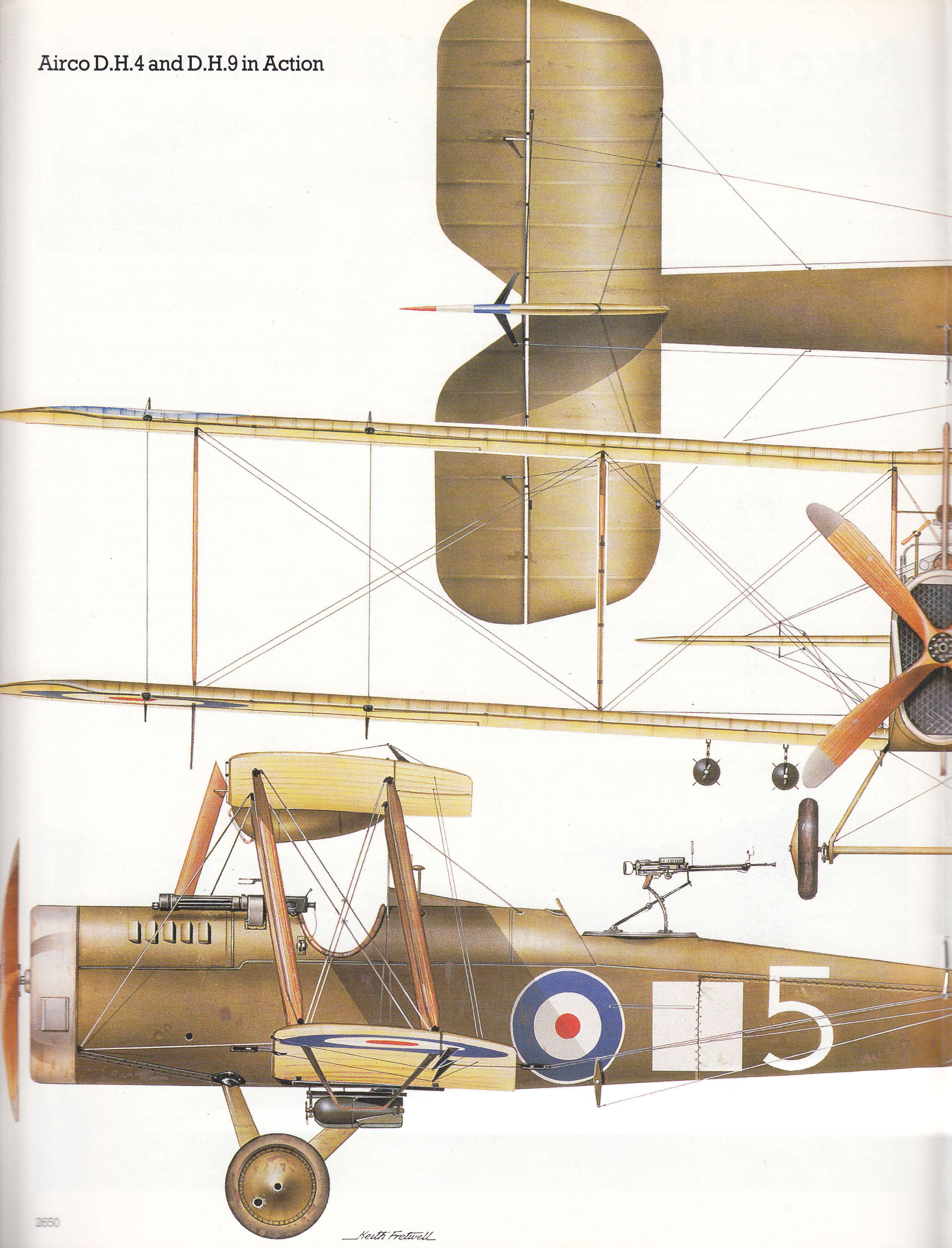
During the great German offensive of March 1918 the pilots of the 9th Wing (Nos 25 and 27 Squadrons) were ordered to adopt low-flying attacks (despite all risks and bad weather) in harassing enemy troops. Such attacks were accompanied by fairly heavy losses, and at the end of the month the squadrons were allowed to resume operations at higher altitude.

RNAS service

At much the same time as the RFC began flying the D.H.4 over the Western Front in the spring of 1917, the Royal Naval Air Service also started introducing the aircraft for all manner of duties in addition to day bombing over German ports. No. 2 (Naval) Squadron (later to become No. 202 Squadron after amalgamation of the RNAS into the new RAF) was the first to receive the aircraft and was tasked with reconnaissance of the Zeebrugge area in preparation for the famous raid by the Royal Navy on 22/23 April 1918. Captain K.G. Boyd of No. 217 Squadron sank the German submarine *UB-12* with two direct hits with 104-kg (230-lb) bombs.

A handful of D.H.4s was sent to the Middle East, but rather larger numbers served with RNAS units in the Aegean. Two D.H.4s, which were sent to strengthen 'C' Squadron on Imbros, carried out a number of bombing attacks on the Sofia-Constantinople railway in November 1917. Two months later naval D.H.4 bombers carried out a series of attacks on the German battle-cruiser *Goeben* aground in the Narrows near the Dardanelles until she was withdrawn from danger; thereafter the D.H.4s, specially modified to provide an endurance of seven hours' flying time, were used to keep an eye on the warship as she lay at anchor near Constantinople. At least one of the RNAS aircraft, based at Mudros on the island of Lemnos, was detached to the Greek airfield of Amberkoj to join the Armstrong Whitworth F.K.8s of No. 17 Squadron RAF in bombing attacks on the retreating Bulgars in September 1918. In Italy the D.H.4s of Nos 224, 226 and 227 Squadrons (based at Adrano, Otranto and Taranto) carried out bombing raids on the submarine bases at Cattaro and Durazzo.

The US 11th Aero Squadron (Day Bombardment) pose with their US-built, Liberty-engined D.H.4s at their base at Maulan. By the autumn of 1918 the US Army had significant force in Europe, but the only native-built aircraft used were the British-designed D.H.4.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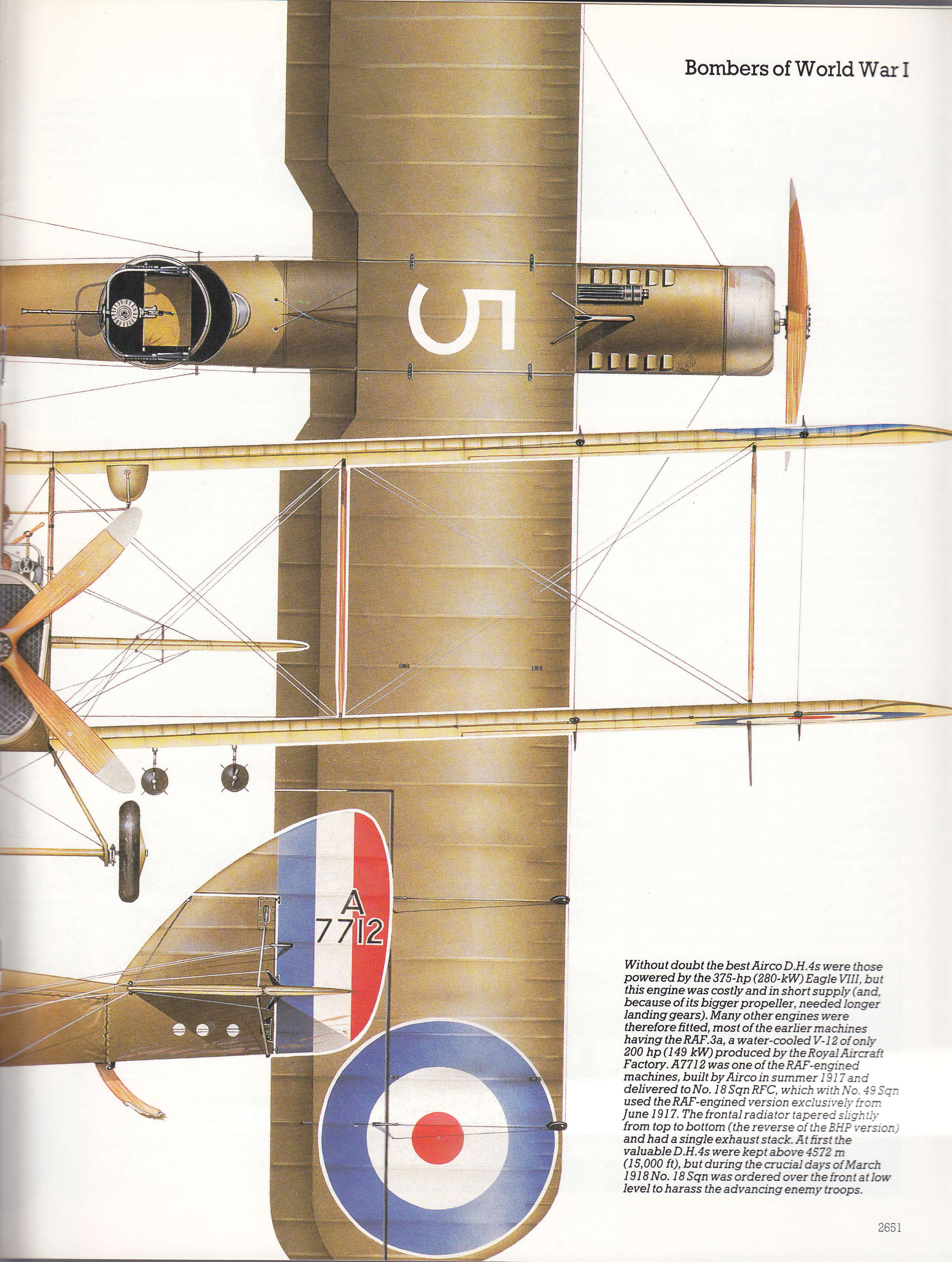
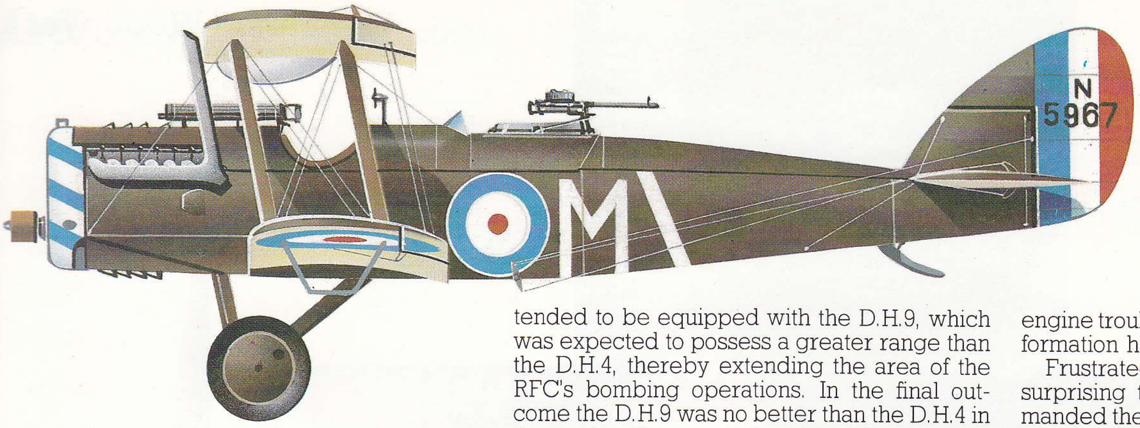
Keith Fretwell



Without doubt the best Airco D.H.4s were those powered by the 375-hp (280-kW) Eagle VIII, but this engine was costly and in short supply (and, because of its bigger propeller, needed longer landing gears). Many other engines were therefore fitted, most of the earlier machines having the RAF.3a, a water-cooled V-12 of only 200 hp (149 kW) produced by the Royal Aircraft Factory. A7712 was one of the RAF-engined machines, built by Airco in summer 1917 and delivered to No. 18 Sqn RFC, which with No. 49 Sqn used the RAF-engined version exclusively from June 1917. The frontal radiator tapered slightly from top to bottom (the reverse of the BHP version) and had a single exhaust stack. At first the valuable D.H.4s were kept above 4572 m (15,000 ft), but during the crucial days of March 1918 No. 18 Sqn was ordered over the front at low level to harass the advancing enemy troops.



A Westland-built D.H.4, probably serving with No. 5 (Naval) Squadron, Royal Naval Air Service, in the spring of 1918. After the formation of the Royal Air Force on 1 April 1918, this was renumbered No. 205 Squadron, Royal Air Force.

The D.H.4 was the only British aircraft selected for production in the USA to see combat service in France with the American Expeditionary forces; indeed by the end of the war more than twice the number of British-built aircraft had been produced in the USA. Powered mostly by Liberty engines, the American D.H.4s equipped a total of 13 operational squadrons, of which five were bomber units. Among the most famous bombing operations of the last year of the war was the great attack by 200 bombers, commanded by William Mitchell and accompanied by 150 escorting scouts, on the German army as it attempted to concentrate for a counterattack against the Allied offensive in the Argonne-Meuse area. Indeed the effectiveness of this raid was to colour Mitchell's views on the use of bombers and was to have a profound influence on the future policies of the US Army Air Corps.

By the end of the war D.H.4s had equipped 25 squadrons of the RFC, RNAS and RAF; a small number of the aircraft operated with the British forces sent to Archangel in May 1918, while others were sent later to Baku in Azerbaijan to support British naval forces in the Caspian Sea, taking part in bombing attacks on the Bolshevik-held port of Astrakhan at the mouth of the Volga.

The D.H.9 and 'Nine-Ack'

Because the D.H.9A survived in service so much longer than the D.H.4 it gained lasting fame, yet during the war enjoyed a far less distinguished career than the earlier aeroplane, being summed up by the squadrons as a 'D.H.4 which has been officially interfered with to suit it for mass production'. Indeed, except when powered by the 430-hp (321-kW) Lion engine, its performance was markedly inferior.

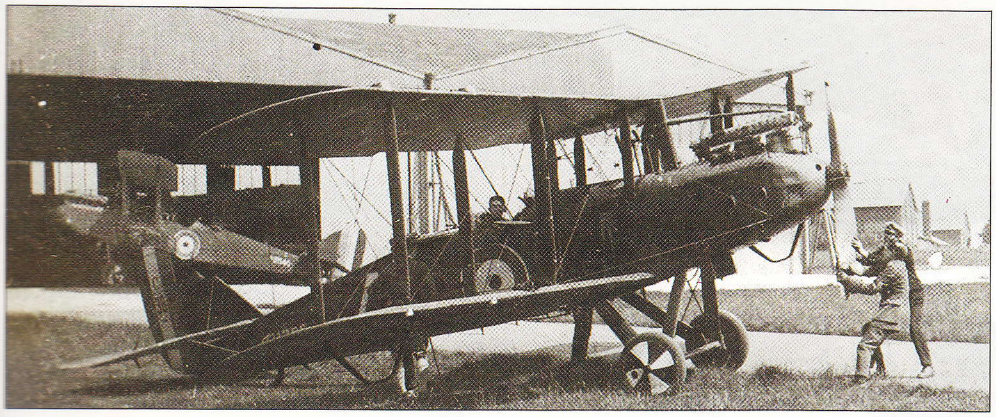
The raison d'etre of the D.H.9 was to increase the RFC's bombing potential. On 21 June 1917 the War Office decided to increase the number of squadrons from 108 to 200, the majority of the new units being bomber squadrons intended to be equipped with the D.H.9, which was expected to possess a greater range than the D.H.4, thereby extending the area of the RFC's bombing operations. In the final outcome the D.H.9 was no better than the D.H.4 in the matter of range, and could seldom carry as much bombload; only when the improved D.H.9A appeared in service in the last three months of the war was any improvement apparent. The principal weakness of the D.H.9 was its BHP engine, the officially-favoured powerplant which happened not to lend itself to mass production and gave constant trouble in service.

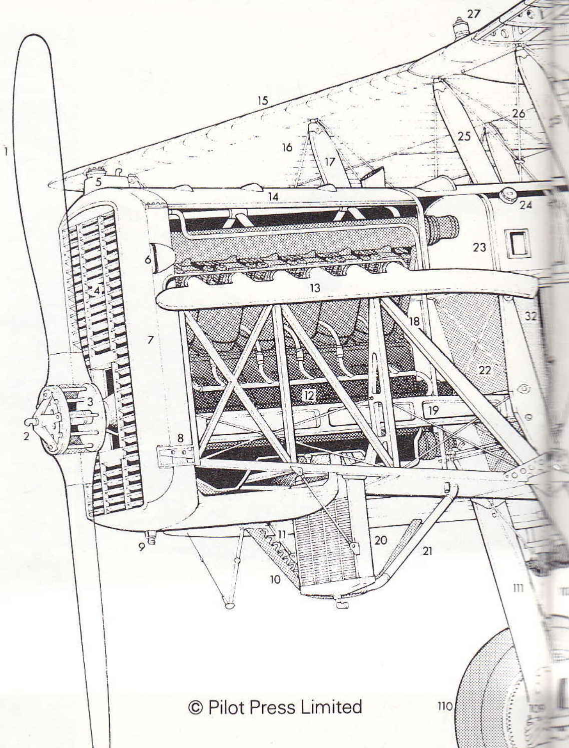
The first aircraft to reach France equipped Nos 98, 206 and 211 Squadrons of the new RAF in April 1918, some of these D.H.9s participating in the Battle of the Lys that month, and dropping more than 600 51-kg (112-lb) bombs in the front-line areas. As with the D.H.4, however, it was with the Independent Force that the D.H.9 saw most service, equipping Nos 99 and 104 Squadrons. Between June and November 1918 these two squadrons flew a total of 83 raids. A measure of the problems being encountered may be judged by the fact that during these attacks no fewer than 123 aircraft had to return early with engine trouble. Moreover, while the D.H.4s were able to hold their own in the face of German scouts, the D.H.9 was exceedingly vulnerable, a fact that was quickly exploited by the defending scouts. On 31 July 12 D.H.9s of No. 99 Squadron set out to bomb Mainz. Three soon returned with engine trouble, another was shot down by scouts over Saaralbe and three more near Saarbrücken; the survivors dropped their bombs on that town and turned for home, but three more were shot down before the leader, Captain A.H. Taylor, and one other survivor landed at their base at Azelot. In an even worse debacle, 29 D.H.9s of Nos. 27 and 98 squadrons took off to bomb the railway junction at Aulnoye on 1 October, but no fewer than 15 turned back with engine trouble, with the result that the reduced formation had to abandon its raid.

Frustrated by such raid failures it was not surprising that Trenchard acrimoniously demanded the immediate introduction of the Libery-powered D.H.9A (the 'Nine-Ack') which had been undergoing leisurely development since late in 1917, although the first American engines did not arrive in the UK until the spring of 1918. No. 110 Squadron with D.H.9As joined the Independent Force at the end of August, but flew only five bombing raids before the end of the war; in the last two months of operations the squadron lost 45 aircraft, and only two of its attacks were deemed successful to any extent. Both the D.H.9 and 9A fared rather better in the eastern Mediterranean and in Palestine, although their operations were generally on a smaller scale than even those of the D.H.4.

The lessons of the bombing operations by relatively small aircraft in daylight, such as the D.H.4 and 9, were there for the learning. The Americans usually employed much larger formations, often with accompanying fighter escort; occasionally losses were suffered, but seldom such as to reduce the effectiveness of the raids by a significant degree. Despite the relatively light bomb loads carried, damage was inflicted out of all proportion when compared with that by the small formations of British aircraft whose squadrons were frequently all but overwhelmed by opposing fighting scouts. Yet it took the RAF 22 more years to learn the folly of committing small formations of unescorted bombers to daylight raids in the likely presence of fighter opposition.

The D.H.9 (seen here at Eastchurch in 1919) should have been an improvement on the D.H.4, and indeed in terms of design it was. However, powerplant problems gave the new model a performance that was distinctly inferior to that of its predecessor.





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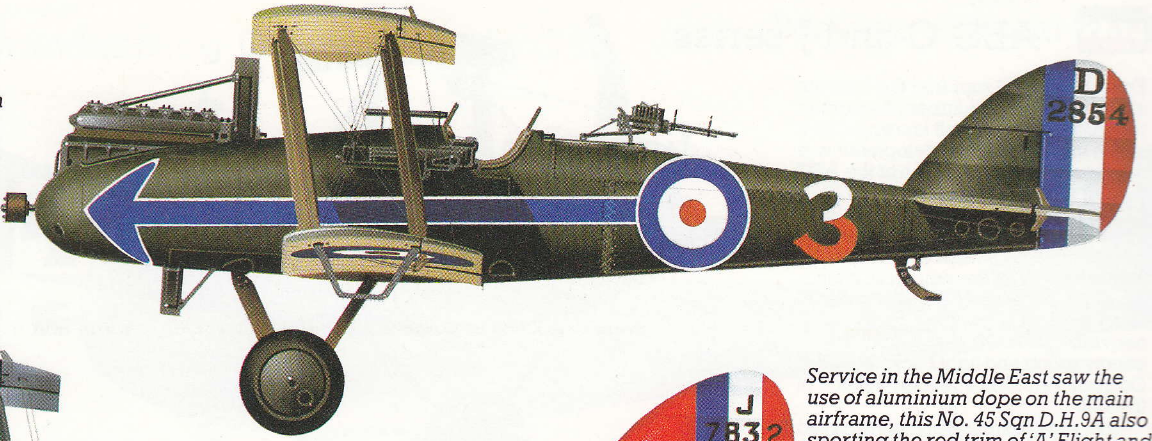
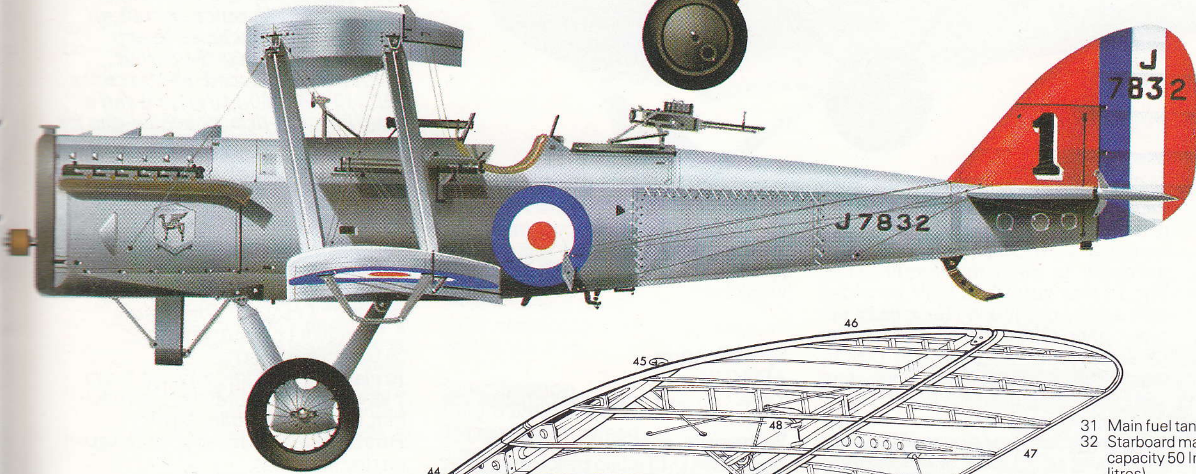
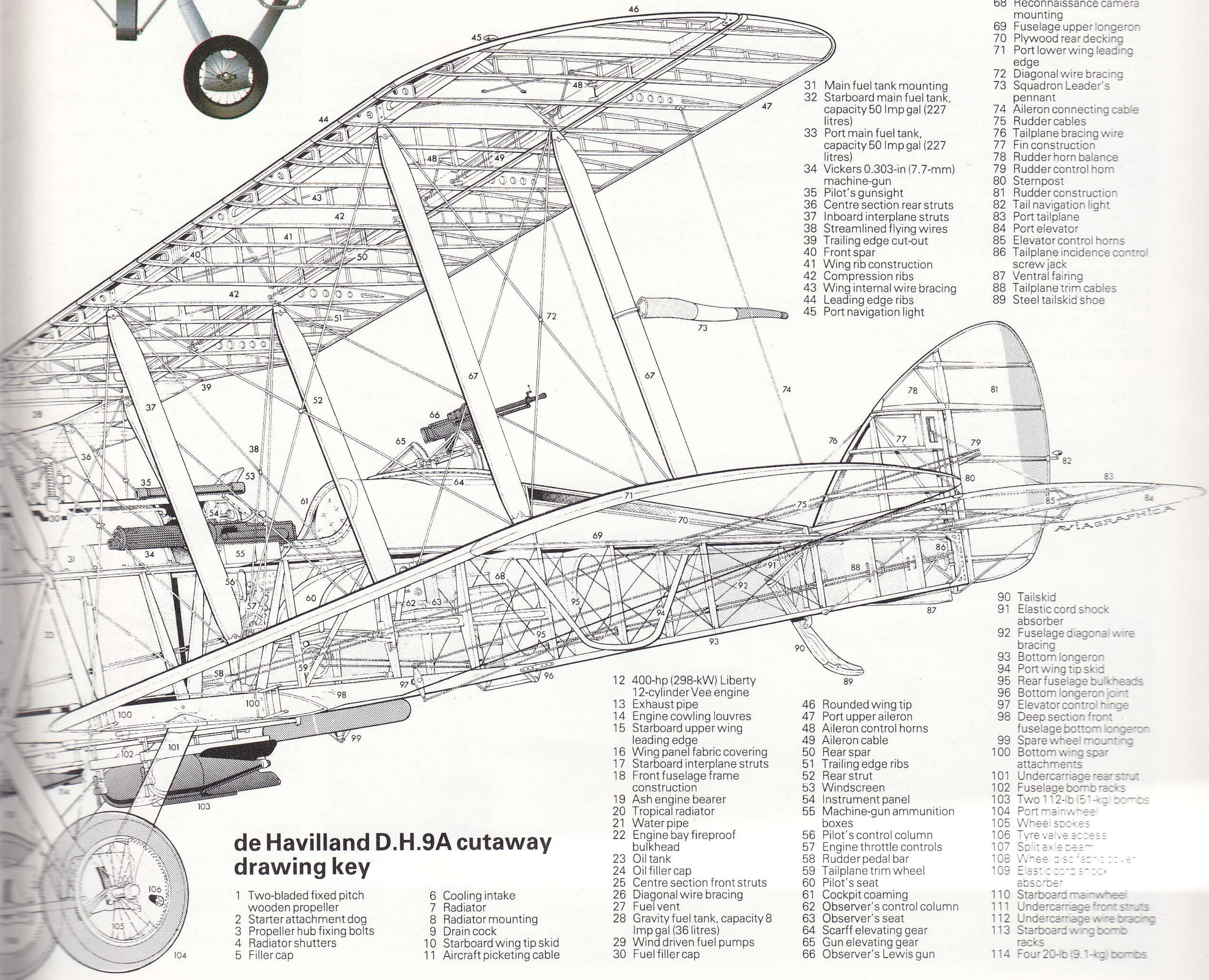
D.H.9 no. D2854 served with No. 221 Sqn during the Allied intervention in Russia after the war. Seen as it appeared in January 1919 at Petrovsk, it was later handed to the White Russians when the RAF withdrew in August of that year.





Service in the Middle East saw the use of aluminium dope on the main airframe, this No. 45 Sqn D.H.9A also sporting the red trim of 'A' Flight and the winged camel badge signifying the squadron's long association with the Middle East. This aircraft was based at Heliopolis in 1928 for patrol duties in Egypt and Palestine. Note the auxiliary radiator under the nose for desert use.

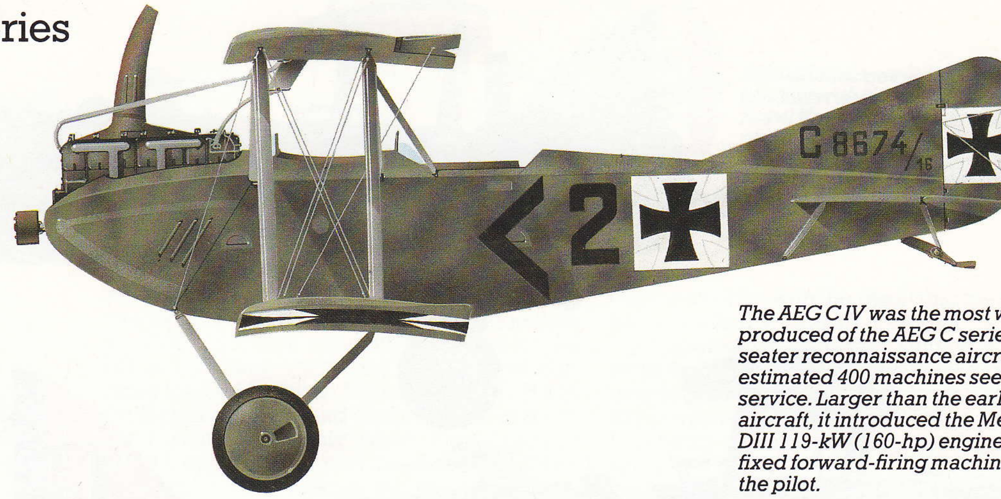


de Havilland D.H.9A cutaway drawing key

1 Two-bladed fixed pitch wooden propeller
2 Starter attachment dog
3 Propeller hub fixing bolts
4 Radiator shutters
5 Filler cap
6 Cooling intake
7 Radiator
8 Radiator mounting
9 Drain cock
10 Starboard wing tip skid
11 Aircraft picketing cable
12 400-hp (298-kW) Liberty 12-cylinder Vee engine
13 Exhaust pipe
14 Engine cowling louvres
15 Starboard upper wing leading edge
16 Wing panel fabric covering
17 Starboard interplane struts
18 Front fuselage frame construction
19 Ash engine bearer
20 Tropical radiator
21 Water pipe
22 Engine bay fireproof bulkhead
23 Oil tank
24 Oil filler cap
25 Centre section front struts
26 Diagonal wire bracing
27 Fuel vent
28 Gravity fuel tank, capacity 8 Imp gal (36 litres)
29 Wind driven fuel pumps
30 Fuel filler cap
31 Main fuel tank mounting
32 Starboard main fuel tank, capacity 50 Imp gal (227 litres)
33 Port main fuel tank, capacity 50 Imp gal (227 litres)
34 Vickers 0.303-in (7.7-mm) machine-gun
35 Pilot's gunsight
36 Centre section rear struts
37 Inboard interplane struts
38 Streamlined flying wires
39 Trailing edge cut-out
40 Front spar
41 Wing rib construction
42 Compression ribs
43 Wing internal wire bracing
44 Leading edge ribs
45 Port navigation light
46 Rounded wing tip
47 Port upper aileron
48 Aileron control horns
49 Aileron cable
50 Rear spar
51 Trailing edge ribs
52 Rear strut
53 Windscreen
54 Instrument panel
55 Machine-gun ammunition boxes
56 Pilot's control column
57 Engine throttle controls
58 Rudder pedal bar
59 Tailplane trim wheel
60 Pilot's seat
61 Cockpit coaming
62 Observer's control column
63 Observer's seat
64 Scarff elevating gear
65 Gun elevating gear
66 Observer's Lewis gun
67 Outboard interplane struts
68 Reconnaissance camera mounting
69 Fuselage upper longeron
70 Plywood rear decking
71 Port lower wing leading edge
72 Diagonal wire bracing
73 Squadron Leader's pennant
74 Aileron connecting cable
75 Rudder cables
76 Tailplane bracing wire
77 Fin construction
78 Rudder horn balance
79 Rudder control horn
80 Sternpost
81 Rudder construction
82 Tail navigation light
83 Port tailplane
84 Port elevator
85 Elevator control horns
86 Tailplane incidence control screw jack
87 Ventral fairing
88 Tailplane trim cables
89 Steel tailskid shoe
90 Tailskid
91 Elastic cord shock absorber
92 Fuselage diagonal wire bracing
93 Bottom longeron
94 Port wing tip skid
95 Rear fuselage bulkheads
96 Bottom longeron joint
97 Elevator control hinge
98 Deep section front fuselage bottom longeron
99 Spare wheel mounting
100 Bottom wing spar attachments
101 Undercarriage rear strut
102 Fuselage bomb racks
103 Two 112-lb (51-kg) bombs
104 Port mainwheel
105 Wheel spokes
106 Tyre valve access
107 Split axle beam
108 Wheel disc fabric cover
109 Elastic cord shock absorber
110 Starboard mainwheel
111 Undercarriage front struts
112 Undercarriage wire bracing
113 Starboard wing bomb racks
114 Four 20-lb (9.1-kg) bombs

GERMANY

AEG C and J series



The AEG C IV was the most widely produced of the AEG C series of two-seater reconnaissance aircraft, an estimated 400 machines seeing service. Larger than the earlier aircraft, it introduced the Mercedes DIII 119-kW (160-hp) engine and a fixed forward-firing machine-gun for the pilot.

From 1914, AEG supplied the German air service with a number of unarmed reconnaissance aircraft known as the B series and little real development was necessary for the evolution of the **AEG C I** that was introduced in March 1915. It carried a 150-hp (112-kW) Benz Bz.III inline engine, and a machine-gun for the observer on a flexible mount in the aft cockpit. With the emphasis changing gradually from a stable reconnaissance platform towards a more manoeuvrable aircraft that could evade enemy scouts and fight back, the **C II** of October 1915 was a refined version of the C I.

The most extensively constructed member of the C series was the **C IV**, its development spurred by the German air service's growing appreciation of the importance of aerial reconnaissance. A little larger than the C II, it introduced the more powerful Mercedes D.III engine, a fixed forward-firing machine-gun for the pilot, and a three-position variable-incidence tailplane that was adjustable on the ground. Production figures for the IV are estimated at 400.

In 1916 the German air service introduced *Infanterie-Flieger* units (infantry contact patrol units), which would now be regarded as close support or ground attack squadrons. Proving to be valuable when used on a small scale during the Battle of Verdun, such units were soon the subject of a high-priority programme of expansion and equipment. AEG's **J I** was developed hurriedly to meet this requirement. The J I was virtually a C IV provided with a 200-hp (149-kW) Benz Bz.IV engine, plus 390 kg (860 lb) of armour plate to protect the crew and powerplant. Two LMG 08/15 machine-guns were mounted in the floor of the aft cockpit, pointing downward and forward at an angle of about 45°, so that they could be used for strafing enemy trenches or columns of infantry on the march. In addition, the observer had a Parabellum machine-gun on a ring mounting. The **J II** of 1918 was generally similar. More than 600 J I/II aircraft were built.

Specification

AEG C IV

Type: two-seat armed reconnaissance aircraft

Powerplant: one 160-hp (119-kW) Mercedes D.III inline piston engine

Performance: maximum speed 158 km/h (98 mph); service ceiling 5000 m (16,405 ft); endurance 4 hours

Weights: empty 800 kg (1,746 lb); maximum take-off 1120 kg (2,469 lb)

Dimensions: span 13.45 m (44 ft 1.5 in); length 7.15 m (23 ft 5.5 in); height 3.35 m (10 ft 11.75 in); wing area 39.00 m^2 (419.81 sq ft)

Armament: one fixed forward-firing 7.92-mm (0.31-in) LMG 08/15 machine-gun, and one 7.92-mm (0.31-in) Parabellum machine-gun for observer on ring mounting

GERMANY

Halberstadt C and CL series

Based on the **Halberstadt B II** two-seater and developed similarly as a reconnaissance aircraft, the **Halberstadt C I** retained the earlier aircraft's slab-sided fuselage, but the crew positions were reversed and the rear (observer's) position was provided with a mounting for a pivoted machine-gun. Towards the end of 1917 the improved **C III** appeared, powered by a 200-hp (149-kW) Benz Bz.IV engine.

The most prolific of the Halberstadt C series was the **C V** high-altitude reconnaissance aircraft, which appeared in 1918. A camera mounted in the rear cockpit could be directed through a sliding hatch in the floor. Developed to act as escort for the C-type reconnaissance aircraft, the **Halberstadt CL II** appeared in 1917 and soon entered service with the *Schützstaffeln* (protection flights) of the Imperial German Aviation Service. The single cockpit had tandem accommodation for pilot and observer, the latter being provided with an elevated gun ring which allowed him to fire his Parabellum machine-gun both upward and forward over the upper wing. Trays were fitted on each side of the fuselage for the carriage of small anti-personnel grenades, or of four or five 10-kg (22-lb) bombs. The CL II soon demonstrated its value to the German high command when, on 6 September 1917, 24 aircraft attacked with great effect British troops crossing the bridges over the Somme at Bray and St Christ. The escort units were then redesignated as *Schlachtstaffeln* (battle flights) for close-support duties and were used extensively during the closing months of 1917, particularly at the Battle of Cambrai on 30 November when the Germans launched a successful counter-offensive.

Specification

Halberstadt CL II

Type: two-seat ground support aircraft and escort fighter

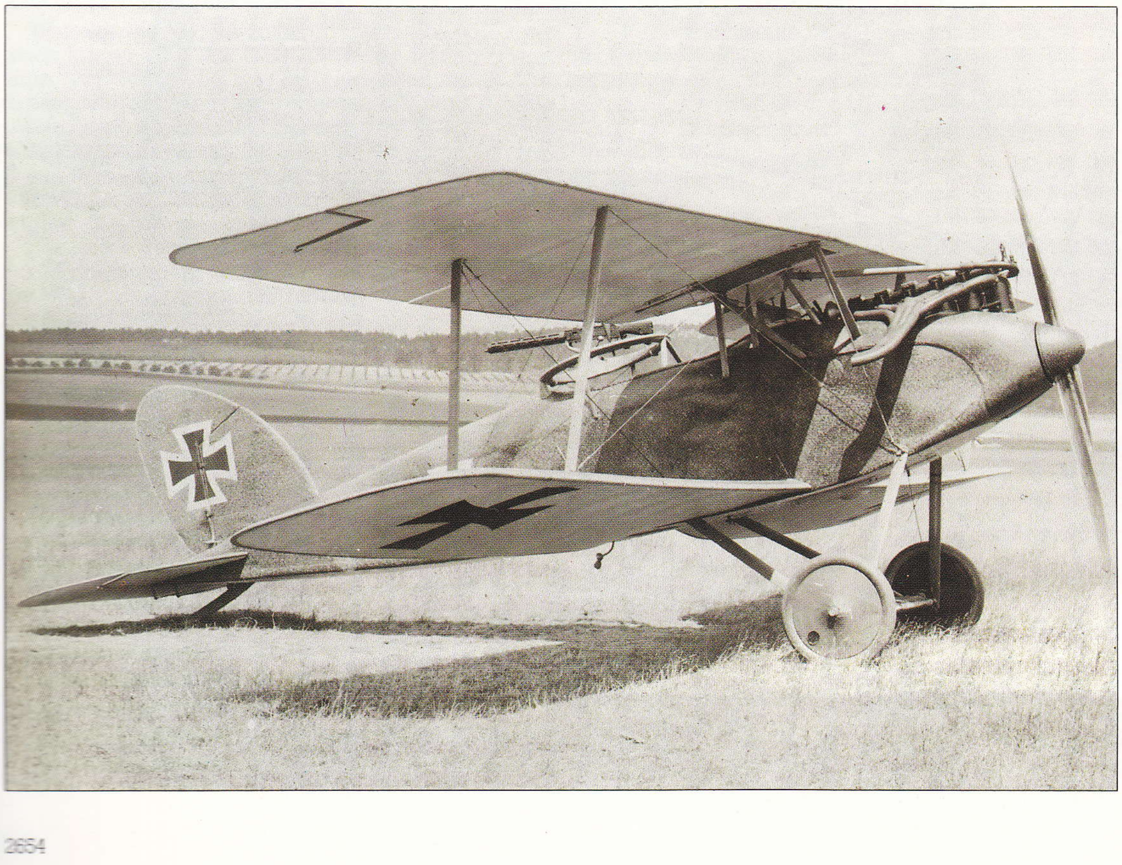
Powerplant: one 160-hp (119-kW) Mercedes D.111 6-cylinder inline piston engine

Performance: maximum speed 165 km/h (103 mph) at 5000 m (16,405 ft); service ceiling 5100 m (16,730 ft); endurance 3 hours

Weights: empty 772 kg (1,701 lb); maximum take-off 1130 kg (2,493 lb)

Dimensions: span 10.77 m (35 ft 4 in); length 7.30 m (23 ft 11.5 in); height 2.75 m (9 ft 0.25 in); wing area 27.50 m^2 (296.02 sq ft)

Armament: one or two fixed forward-firing 7.92-mm (0.31-in) LMG 08/15 machine-guns and one pivoted 7.92-mm (0.31-in) Parabellum machine-gun, plus four or five 10-kg (22-lb) bombs and grenades



Developed to escort reconnaissance flights, the two-seat Halberstadt CL III proved an effective bomber and, carrying racks of light bombs, played an important part in the German counter-attack at Cambrai in 1917.

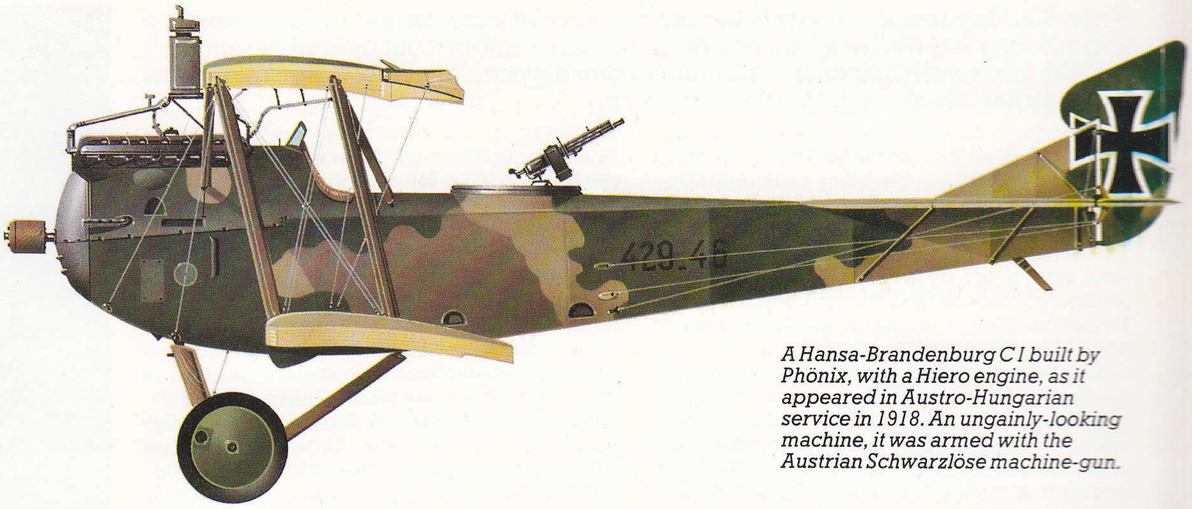
GERMANY/AUSTRIA-HUNGARY

Hansa-Brandenburg C I and Phönix C I

One of the earliest designs of Ernst Heinkel for the Hansa und Brandenburgische Flugzeug-Werke GmbH, the **Hansa-Brandenburg C I** was built extensively for its era, being constructed not only by Brandenburg but also under licence by Phönix and Ufag in Austria. A conventional two-bay biplane of wood and fabric construction, it had a slender fuselage with the powerplant mounted in the nose, provided a combined open cockpit for the pilot and observer/gunner, and mounted a braced tail unit at the rear. Landing gear was of tailskid type.

Entering service in 1916, C Is saw wide-scale use by the Austrian forces and some examples continued in service until the end of World War I. In the long period of time over which they were operational, C Is were seen with powerplants ranging from 160 to 230 hp (119 to 172 kW) and with a variety of armaments. Basically this comprised a single machine-gun on a pivoted mount at the rear of the cockpit, but later versions also had a single forward-firing machine-gun mounted in different positions. Some were used for light bombing missions and were equipped to carry up to 100 kg (220 lb) of light fragmentation or incendiary bombs on racks beneath the fuselage or lower wing.

The Austro-Hungarian aircraft manufacturer Phönix Flugzeug-Werke began with licence-manufacture of Albatros and Brandenburg aircraft, turning to aircraft of its own design. The first of these was the **Phönix C I** two-seat armed reconnaissance and general-purpose biplane, which the company developed from the **Hansa-Brandenburg C II**, which it had built under licence. An ugly but practical aircraft, the C I had fixed tailskid landing gear, was powered by a Hiero inline engine, and accommodated pilot and observer/gunner in tandem open cockpits. Phönix built 110 C Is and these entered service in the spring of 1918, remaining operational until the end of the war.



A Hansa-Brandenburg C I built by Phönix, with a Hiero engine, as it appeared in Austro-Hungarian service in 1918. An ungainly-looking machine, it was armed with the Austrian Schwarzlöse machine-gun.

Specification

Ufag-built C I Srs 169

Type: two-seat armed reconnaissance aircraft

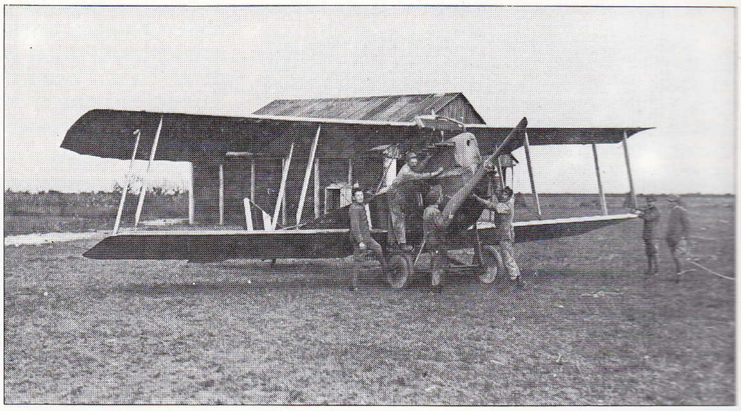
Powerplant: one 220-hp (164-kW) Benz Bz.IVa 6-cylinder inline piston engine

Performance: maximum speed 158 km/h (98 mph); service ceiling 6000 m (19,685 ft)

Weights: empty 820 kg (1,808 lb); maximum take-off 1,320 kg (2,910 lb)

Dimensions: span 12.25 m (40 ft 2.25 in); length 8.45 m (27 ft 8.75 in); height 3.33 m (10 ft 11in)

Armament: (standard) one Schwarzlöse 8-mm (0.315-in) machine-gun on pivoted mount over rear of combined cockpit



Ernst Heinkel began his career designing biplanes for the Austro-Hungarian Empire, and eventually built jets for Hitler. The Hansa-Brandenburg, one of his early designs, was manufactured under licence by Phönix and Ufag in Austria. It served as a reconnaissance aircraft and light bomber.

GERMANY

Junkers early aircraft

In 1910 the German engineer Dr Hugo Junkers patented a flying-wing aircraft; the thick-section cantilever wing that he designed for it was in the first Junkers aeroplane to fly, the **Junkers J 1**, on 12 December 1915. A mid-wing cantilever monoplane, the J 1 was covered by thin sheet iron, gaining it the nickname 'Tin Donkey'. Six generally similar single-seat **J 2** aircraft were built in 1916, these being armed by a single 7.92-mm (0.31-in) LMG 08/15 machine-gun.

Impressed by Junkers constructional techniques, the German air ministry asked for the development of an armoured biplane. This was the **Junkers J 4**, which entered service as a two-seat close-support aircraft towards the end of 1917 under the military designation **J I**. Powered by a 200-hp (149-kW) Benz Bz.IV engine, the J I was covered by corrugated light alloy skins. Powerplant and crew were enclosed in an armoured capsule, the protection which this provided against small-arms fire from the ground making the J I popular with its crews. Production totalled 227.

Junkers then turned to a new series of cantilever low-wing monoplanes, the single-seat **J 7** of 1917 serving as prototype for the **J 9** single-seat fighter which, powered by the 185-hp (138-kW) B.M.W. engine and armed with twin forward-firing LMG 08/15 machine-guns, was built in small numbers under the military designation **D I**.

The **Junkers J 10** was a two-seat version of the J 7 powered by a 180-hp (134-kW) Mercedes D.IIIa engine. About 50 examples of this were built before the armistice, entering service as the **Junkers CL I** and carrying the same armament as the D I. Three examples of a floatplane version of this aircraft entered service with the German navy during 1918 under the designation **Junkers CLS I**.

Specification

Junkers J I

Type: two-seat close-support aircraft

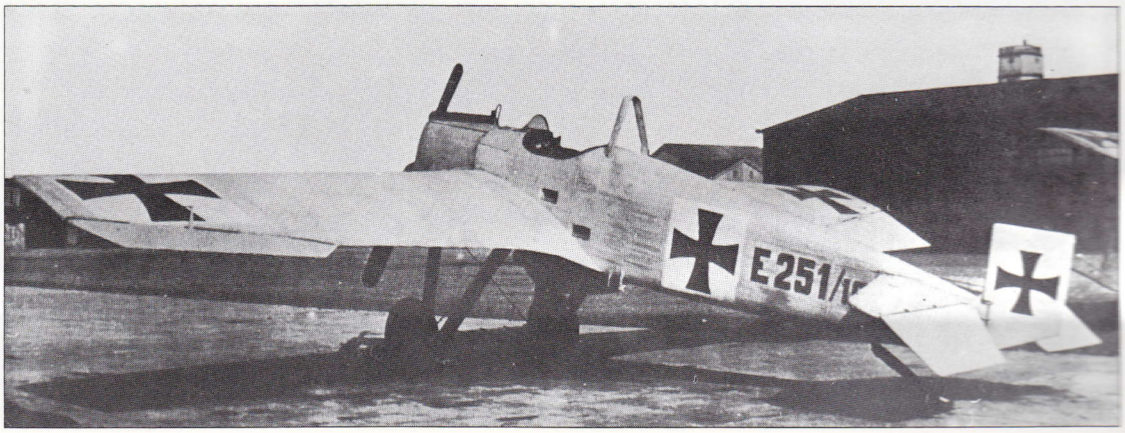
Powerplant: one 200-hp (149-kW) Benz Bz.IV 6-cylinder inline piston engine

Performance: maximum speed 155 km/h (97 mph); endurance 2 hours

Weights: empty 1766 kg (3,885 lb); maximum take-off 2176 kg (4,787 lb)

Dimensions: span 16.0 m (52 ft 6 in); length 9.10 m (29 ft 10.5 in); height 3.40 m (11 ft 1.75 in); wing area 49.40 m^2 (533.52 sq ft)

Armament: two fixed forward-firing 7.92-mm (0.31-in) LMG 08/15 machine-guns and one trainable 7.92-mm (0.31-in) Parabellum machine-gun



The innovative Junkers J 1 metal monoplane was followed by six J 2 aircraft in 1916; this is the second of the group. Thin sheet iron covering the machine led to these and later Junkers aircraft being dubbed 'tin donkeys', although dural sheet was soon introduced.

The Birth of Strategic Bombing

From their introduction into military service, aircraft were used to attack enemy ground forces as well as to conduct reconnaissance patrols, but by 1915 designers on both sides were planning large multi-engined machines able to range far beyond the front line; the strategic bomber was born.

America's leading bombing exponent was Brigadier-General Mitchell, whose controversial bombing trials during July 1921 involved sinking the German Dreadnought Ostfriesland *by aerial bombing.*

No account of the war's strategic bombing efforts by the UK and Germany can begin other than with brief reference to the origins of bombing in the West by lighter-than-air craft, for therein lay the premeditated drift towards total war, if not by deliberate assault on the civilian population then by the knowledge that no means existed to ensure that bombs would only ever fall on military targets.

On the outbreak of war the Kaiser, mindful perhaps of his own family ties with English royalty, had expressed abhorrence at any aerial bombing that might endanger civilians and went so far as to withhold approval for air attacks on targets in England. The Imperial Naval Staff, however, anxious to demonstrate the superiority of its airships in attacks on dockyard and other naval targets in the Thames estuary, managed to persuade the Kaiser to temper his ban on such attacks in return for assurances that such raids would not endanger the civilian population nor indeed the British capital itself. Inevitably, as the navy's (and soon afterwards the army's) airship crews roamed the night skies over England searching for 'military' targets, bombs fell on towns (and London), and civilians were killed. The first such raid occured on the night of 19/20 January 1915 when two Zeppelins dropped bombs on King's Lynn in Norfolk.

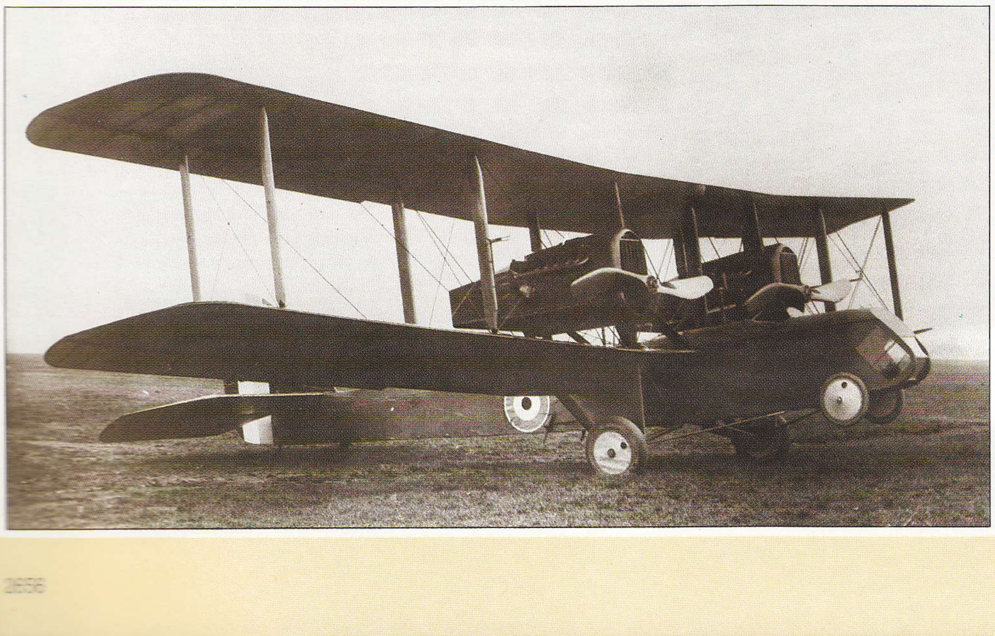
Other raids by airships followed, but it was not until the night of 2/3 September 1916 that the first airship was shot down by an aeroplane over the UK when Lieutenant W. Leefe Robinson of No. 39 Squadron RFC brought down a Schütte-Lanz over Hertfordshire (for which he was awarded the VC). Almost three months later two more airships were destroyed in a single night over the East Coast. Later that same day, 28 November 1916, a single German aeroplane flew brazenly over central London and dropped six small bombs in broad daylight and escaped.

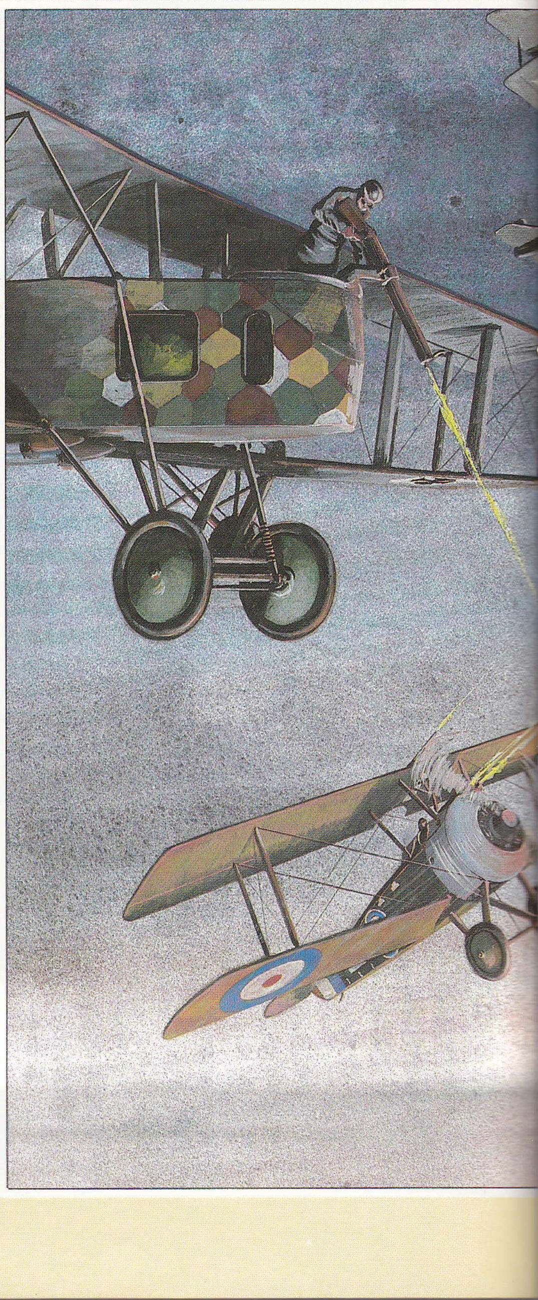
Meanwhile Germany, and more particularly the German army, had been at work developing the aeroplane as a bomb-carrier, at first creating several units of Tauben (aircraft with dove-shaped wings) able to reach just beyond the battle front with a few very small bombs. However, spurred by the achievements of the big Russian Sikorsky bombers which had been active in the East, and frustrated by the inability of the Tauben to reach worthwhile targets in England, the German aircraft industry set to work early in 1915 to evolve much larger bombers, the G-class, *Grosskampfflugzeug* or 'battleplane'. These aircraft, from AEG, Gotha, Friedrichshafen and other makers, started reaching operational units before the end of the year but it was not for another year, after the creation of the Luftstreitkrafte (air force) under an officer of field rank, General Ernst von Hoeppner, that plans were hatched for a sustained air attack by aeroplanes on England. By then improved aircraft, notably the Friedrichshafen G III and Gotha G IV, had flown and the plans included the formation of three *Kampfgeschwader* (bomber wings), of which Kagohl 3 would be committed to raids on England, and the others against targets in France.

Belgian bases

In due course the new bomber wing, comprising six *Staffeln* and commanded by Hauptmann Ernst Brandenberg, occupied its bases in Belgium. On 25 May 1917 23 Gotha G IVs set out to attack London in daylight after losing two aircraft in force landings in Belgium. Crossing the Essex coast near Burnham-on-Crouch, Brandenberg found his path to the capital obscured by cloud so turned south to see if his crews could find worthwhile targets in Kent. Eventually the formation arrived over Folkestone where the Gothas released nearly five tons of bombs, killing 95 and injuring 260. Although the Dover anti-aircraft guns opened fire with a heavy barrage and about 40 British aircraft took off in pursuit, the Gothas escaped,

Despite the best endeavours of the RFC and the anti-aircraft guns, landing accidents accounted for the majority of German bomber losses on most raids. This D.H.10 shows that the British encountered similar problems; both sides in fact fitted nose wheels to some aircraft to prevent them nosing in.





only to lose two more of their number in forced landings.

This raid provoked an angry outburst in the British parliament which was still rumbling on when, on 5 June, Brandenberg launched his second raid, this time killing 45 people in the naval dockyard at Sheerness. One week later, on 13 June, 20 Gothas set out for London, their aiming point the railway terminus of Liverpool Street. The formation reached the capital where it dropped more than four tons of bombs; three bombs actually struck the aiming point but another hit an infants' school at Poplar, killing 16 children. In all, this raid killed 162 and injured 432, the highest toll of any single raid on the UK during the war.

The outcry in the British parliament now reached new heights which quickly provoked action to strengthen the defences, and resulted in the formation of a commission headed by the South African, General Jan Smuts, to examine the entire structure of the RFC and RNAS and their ability to provide adequate home defence. The recommendations of this commission were far-reaching and eventually led to the amalgamation of the two 'services' to form the Royal Air Force on 1 April 1918.

In the meantime Kagohl 3 carried out several more attacks on south east England, but on a diminishing scale as a result of losses, mainly from accidents but also to a growing number in combat. This sapping of strength resulted in the decision being taken to switch to night raiding, any pretence at confining attention to military targets having long since dissipated. Ironically, however, the first such raid by only four Gothas on 3/4 September struck the naval barracks at Chatham where a single 51-kg (112-lb) bomb caused the deaths of 131 sleeping ratings and injury to 90 others (the highest toll from any single bomb during the war).

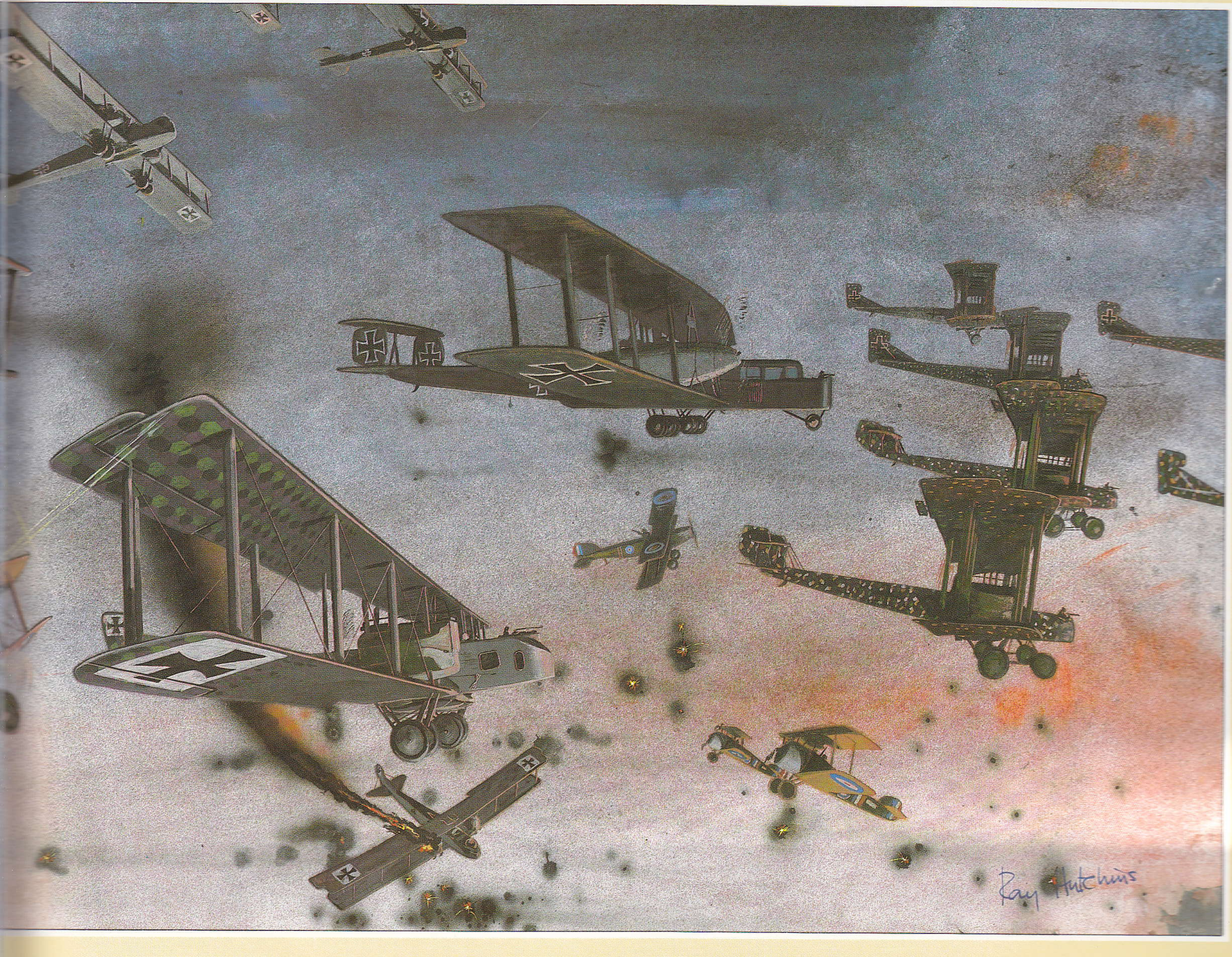
Later the same month the Gothas were joined by a new squadron, Riesenflugzeugabteilung 501 commanded by Hauptmann Richard von Bentivegni, one of two such units now flying the huge R-type 'Giant' bombers. Such was the size of these aircraft (the Zeppelin-Staaken aeroplanes were powered by four, five or even six engines) that each could carry the same bombload as five Gothas. Indeed, when a second raid reached London on 29/30 September with four Gothas and three Giants, the British authorities estimated that 18 Gothas had attacked the capital.

In 1918, however, as the fruits of the RAF reorganization matured, a growing toll was taken of the raiders (though no Giant was ever shot down), and on 19/20 May that year they flew their last attack against England when 28 Gothas and three Giants straggled in over Kent and Essex; no fewer than six Gothas were brought down by night-flying Sopwith Camel and RAF S.E.5A fighters (and one Bristol F.2B) as well as the gun defences. Over the continent sporadic raiding by Kagohl 2, Rfa 500 and Rfa 501 continued until 30 October, when a final attack hit an army supply base at Menin.

The British Independent Force

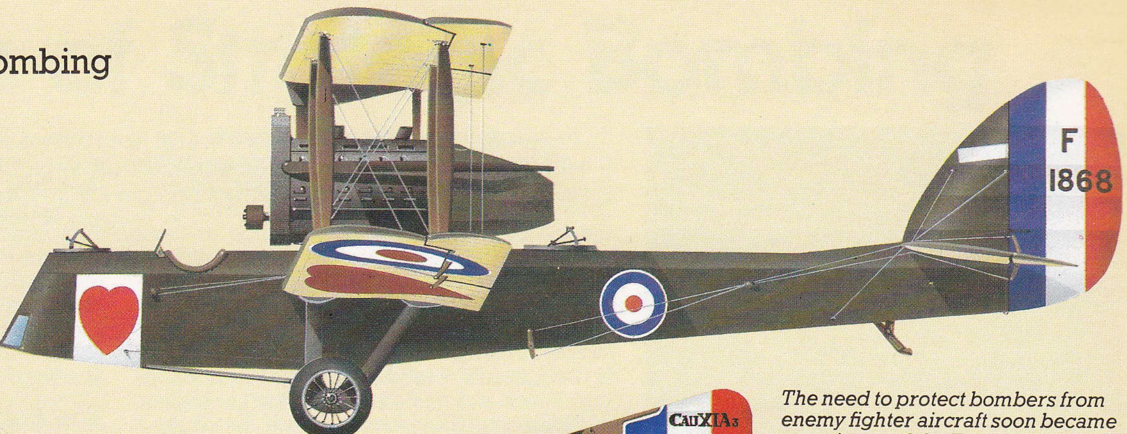
The German strategic bombing effort reached its climax before the end of 1917 and thereafter declined. By contrast, the British attempts to undertake bombing beyond the immediate area of the Western Front started to gain impetus only at the end of 1917, but increased progressively right up to the end of the war. Another feature of the British bombing

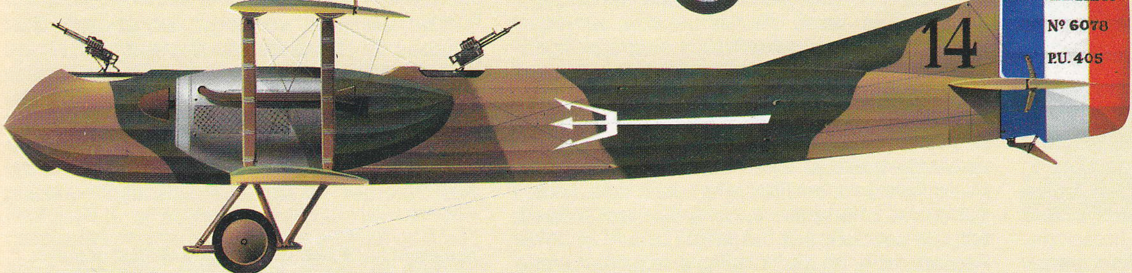
The night of 19/20 May 1918 saw the last of the major night raids on England, when 28 'G' type and three of the giant 'R' type bombers converged on London. Night-flying Sopwith Camels and S.E.5As, together with the ground-based AA artillery, brought down six of the intruders.



The Birth of Strategic Bombing

The Airco D.H.10, like the Vickers Vimy and the Handley-Page V 1500, was designed to conduct a strategic bombing campaign against Germany. Only eight of the 1,295 ordered had been delivered when the war ended. Nevertheless, 220 machines were finally produced for the RAF post-war.





The need to protect bombers from enemy fighter aircraft soon became pressing, and the French developed a long-range fighter, the Caudron R 11, to escort formations of Breguet 14B2s. This is a machine of Escadrille C.46 as it appeared between February and November 1918. It carried five Lewis guns; twin nose and dorsal mounts, and one firing down from the nose.

force was the scale of participation by the Royal Naval Air Service; indeed from the outset the entire heavy bomber force (composed of Handley Page O/100s) was naval-crewed, a predominance that only lost its identity when the RNAS and RFC amalgamated to form the RAF.

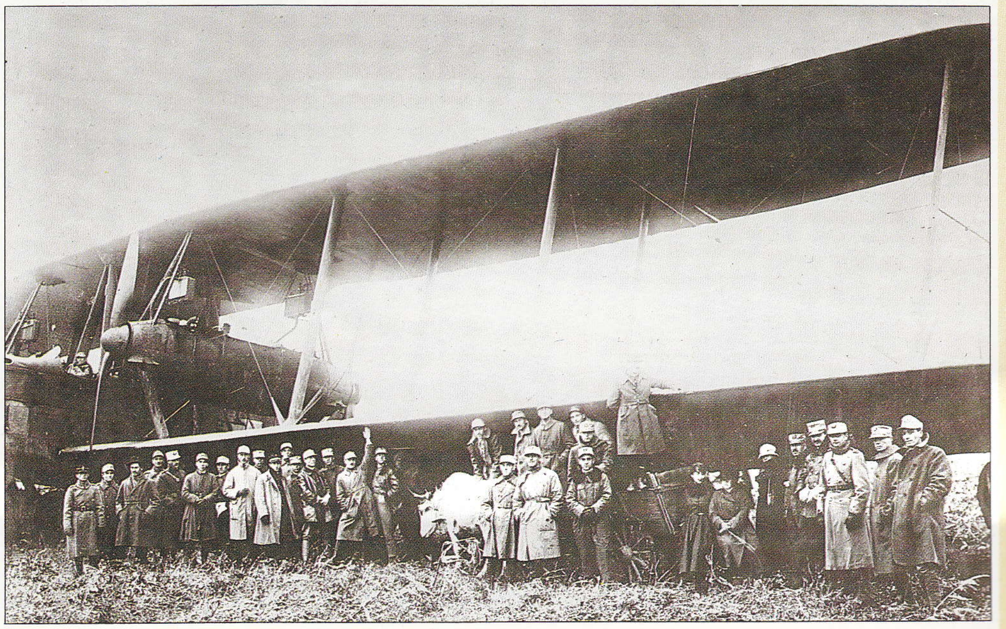
The O/100 stemmed from an informal enquiry addressed by Murray Sueter to Frederick Handley Page early in 1915 whether he could produce 'a bloody paralyser', by implication a big aeroplane capable of carrying a large bombload. Already working on such an aircraft that had been loosely defined by the Admiralty, Handley Page modified his design to take more powerful engines, this aircraft, the O/100, being flown in December that year. Entering service with the 5th Naval Wing at Dunkerque the following November, the big bomber could carry up to sixteen 51-kg (112-lb) bombs and started daylight operations with No. 7 (Naval) Squadron in April 1917 along the Belgian coast; soon afterwards the 5th Wing changed its operations to night raiding of targets immediately behind the Western Front; further south the 3rd Wing, also equipping with O/100s, embarked on night raids on German industrial centres up to 95 km (60 miles) behind the front. One aircraft, flown by Flight-Lieutenant John Alcock (who later achieved fame for his transatlantic flight) from Mudros, set out to bomb Constantinople but was forced to ditch in the Sea of Xeros, the crew being taken prisoner.

While 46 O/100s were produced, Handley Page developed an improved version, the O/400; this aircraft achieved considerable production with about 400 completed by Handley Page and a further 107 in the USA before the end of the war. Meanwhile the RFC had begun to assemble a bombing force in France composed of No. 55 Squadron's Airco D.H.4, No. 100 Squadron's F.E.2b and the Naval 'A' Squadron's O/100 aircraft. Commanded by Lieutenant-Colonel Cyril Newall, the 41st Wing was formed on 11 October 1917 to continue the bombing of German industrial targets started by the RNAS' 3rd Wing. Before the month was out the D.H.4s and O/100s had raided the Burbach works near Saarbrücken and the F.E.2b aircraft had bombed railways near Falkenburg. Raiding by these squadrons continued through the winter, and on 1 February 1918 the force was raised to brigade status (becoming VIII Brigade), and on 6 June it was renamed the Independent Force of the RAF, commanded by Major General Sir Hugh Trenchard. Between then and the end of the war this force increased to 11 squadrons with a total of about 75 D.H.4s, D.H.9s and D.H.9As, some 50 O/400s and a squadron (No. 45) of Camels. Among the targets attacked during the last six months (mostly by night) were Baden, Bonn, Cologne, Koblenz, Darmstadt, Düren, Frankfurt, Heidelberg, Kaiserslautern, Karlsruhe, Ludwigshafen, Mainz, Mannheim, Luxembourg, Offenburg, Saarburg, Saarbrücken, Stuttgart, Wiesbaden and Zweibrücken, as well as numerous airfields and other military targets. The raids involved the dropping of about 550 tons of bombs (compared with less than a tenth of this figure dropped in all the raids on the UK) and a total of 352 aircraft was lost, including 148 D.H.9s and 69 O/400s.

Clearly the achievements of the Independent Force eclipsed those of the relatively small number of German bombers, and from such reports as were produced after the Armistice it is clear that a far higher proportion of bombs fell on strictly military and strategic targets than was the case of the German bombing; nevertheless, on account of the much greater tonnage of bombs dropped on Germany, civilian casualties were more than double those suffered in the UK.

One other weapon was being prepared for use over Germany when the Armistice brought an end to hostilities. This was the very large Handley Page V/1500, comparable in size to the German Giants but a much more formidable aeroplane. Conceived with the intention of bombing Berlin from bases in the UK, this great aircraft was capable of carrying a 1497-kg (3,300-lb) bomb, and at the moment the Armistice came into effect on 11 November 1918 three V/1500s were standing on Bircham Newton airfield in Norfolk, fully fuelled and bombed-up, awaiting orders to take off for the German capital. As it was, the only such aircraft ever to drop its bombs in anger did so on the city of Kabul during the Afghan War of 1919.

Romanian troops pose beside one of the giant German 'R' class bombers captured in Bessarabia. Romanian troops had been among the first victims of ground attack aircraft, bombarded with water melons by Bulgarian fliers in the Balkan wars. In five years aircraft had become serious fighting machines, and weapons much deadlier.



GERMANY

AEG G series

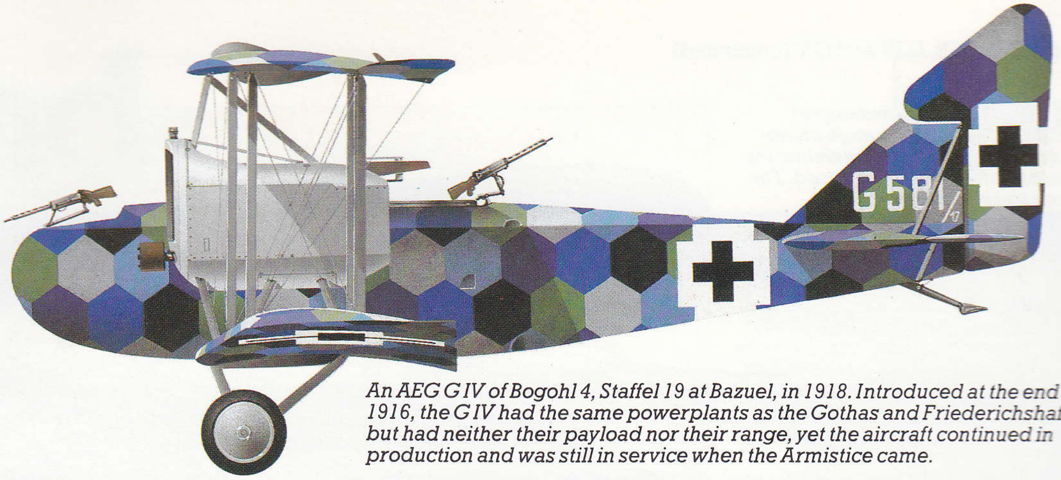
The introduction of bomber squadrons to the Western Front in World War I was not long delayed, Germany initiating *Kampfstaffel* (battle squadron) units in early 1915. The aircraft that equipped them were used primarily as multi-gun fighters, but the potential of tactical and strategic bombing was soon appreciated. It was in 1915 that the first of AEG's twin-engined bombers appeared. The biplane **AEG G I** powered by two 100-hp (75-kW) Mercedes D.I engines. These powerplants were hardly adequate to confer sparkling performance on what was little more than an enlarged C IV: one that was 75 per cent heavier and yet had only about 24 per cent more power. Perhaps it was not surprising that only a single example was built.

The **G II**, first seen in mid-1915, was slightly larger but had two 150-hp (112-kW) Benz Bz.III engines. Only about 15 of these G IIs were built before the **G III** was introduced, and this also was produced in only limited numbers.

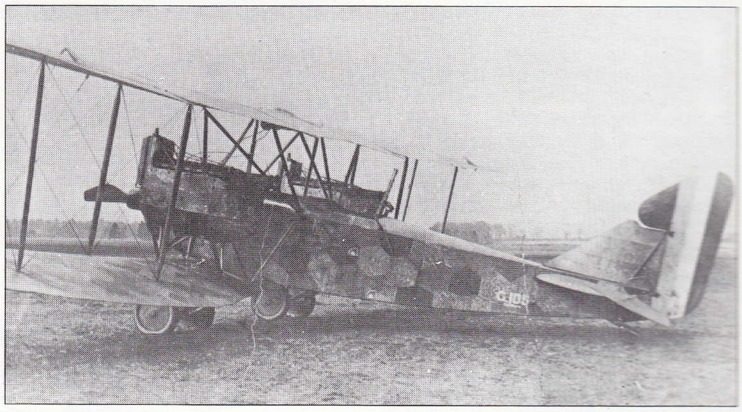
It was not until the end of 1916 that the **G IV** began to enter service. Like its predecessors it had a basic steel-tube structure and fabric covering. All cockpits were interconnected, enabling crew members to change positions in flight if circumstances so dictated. The G IV was hampered by a range that was very limited when the aircraft was carrying a crew of three and a maximum bombload of 400 kg (882 lb).

AEG's G series production totalled almost 550 aircraft, of which about 500 were G IVs, many of them remaining in service until the end of the year. Variants, built in only very small numbers, included the **G IVb** with an increased span three-bay wing; the **G IVK** with a Becker cannon of 20-mm calibre installed in the nose.

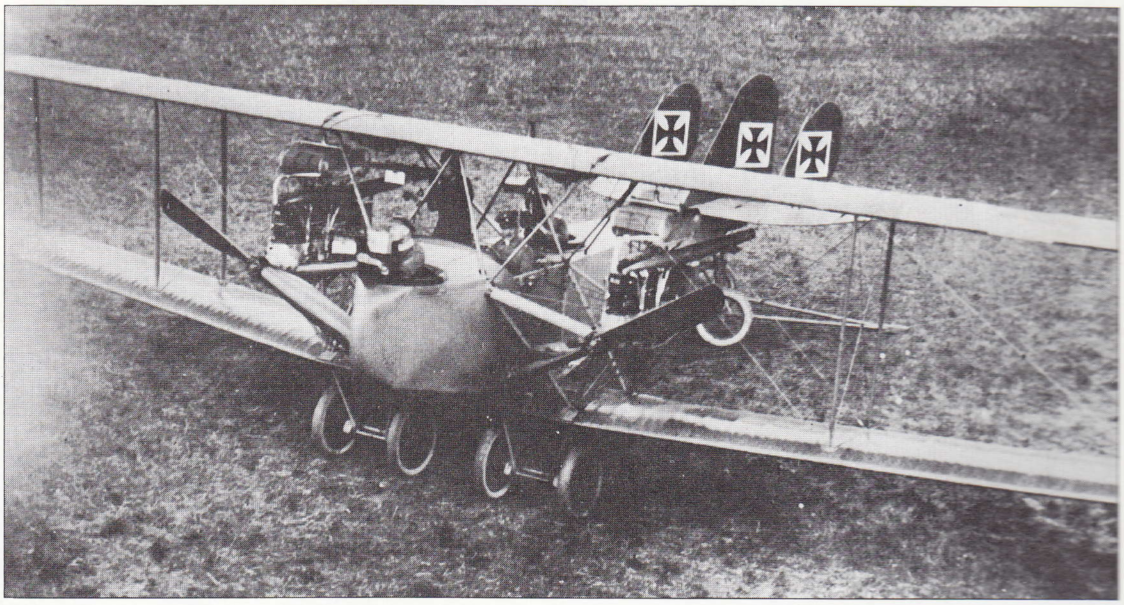
Specification
AEG G IV
Type: biplane bomber/reconnaissance aircraft
Powerplant: two 260-hp (194-kW) Mercedes D.IVa inline piston engines
Performance: maximum level speed 165 km/h (103 mph); service ceiling 4500 m (14,765 ft); maximum endurance 5 hours
Weights: empty 2400 kg (5,291 lb); maximum take-off 3630 kg (8,003 lb)
Dimensions: span 18.40 m (60 ft 4.5 in); length 9.70 m (31 ft 9.75 in); height 3.90 m (12 ft 9.5 in); wing area 67.00 m² (721.21 sq ft)
Armament: two 7.92-mm (0.31-in) Parabellum machine-guns, one on ring mounting in forward cockpit and one on rail mounting in aft cockpit



An AEG G IV of Bogohl 4, Staffel 19 at Bazuel, in 1918. Introduced at the end of 1916, the G IV had the same powerplants as the Gothas and Friederichshafens but had neither their payload nor their range, yet the aircraft continued in production and was still in service when the Armistice came.



***Right:** At a time when other German twin-engined machines favoured pusher arrangement, AEG installed its engines as tractor units on all its twin-engined aircraft. Five hundred and forty-two G types were produced and were used for short-range missions.*

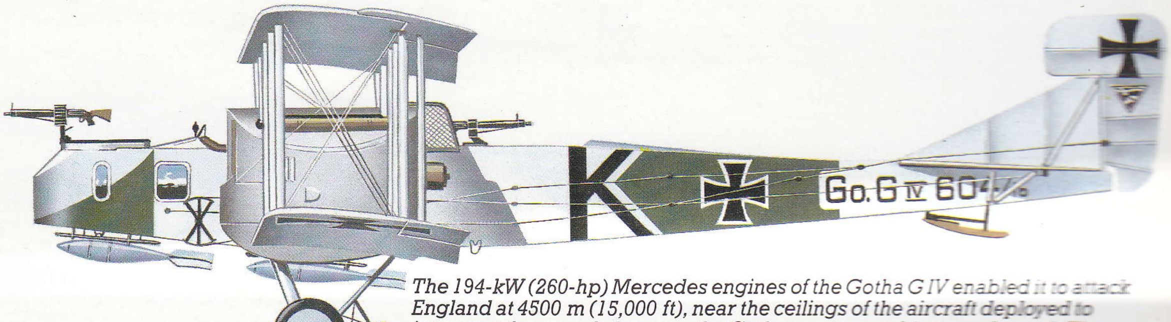


The AEG G II appeared in July 1915 and paved the way for the G IV. Only about 15 were manufactured, but several did see active service with the Kampfgeschwader over the Western Front. It could carry 200-kg (441-lb) of bombs and mounted two or three machine-guns.

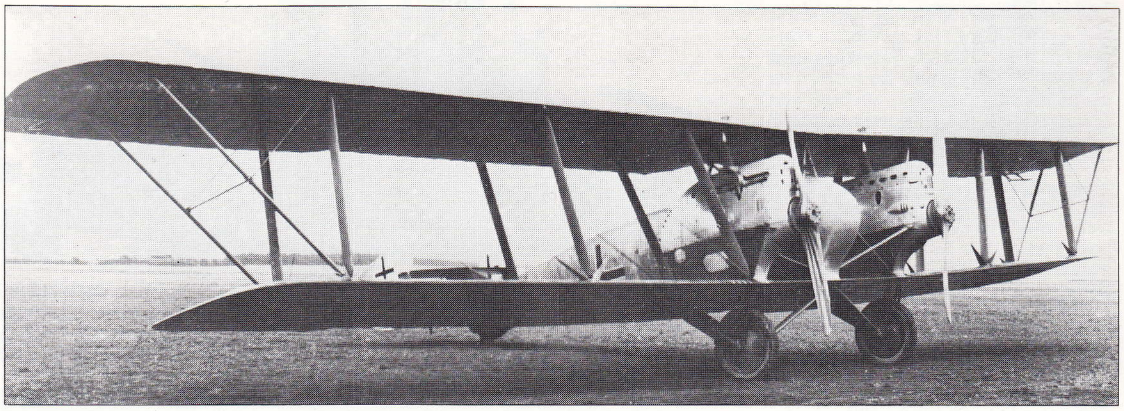
GERMANY

Gotha G II, G III, G IV and G V

During 1917 and 1918 British people generally, and those who lived in London particularly, came to dread air attacks by the 'Gothas', a name which they applied indiscriminately to all German bombers making day or night raids. Development by Gotha of aircraft in this class had started during 1915, and the first of these twin-engine bombers were the **Gotha G II** and **G III** of 1916. Built in only small numbers they were generally similar, differing only in internal detail, but early experience of these aircraft operating in Europe brought development during 1916 of the longer-range **G IV**. Of mixed wood and steel construction,



The 194-kW (260-hp) Mercedes engines of the Gotha G IV enabled it to attack England at 4500 m (15,000 ft), near the ceilings of the aircraft deployed to intercept them, and also gave the Gothas a respectable turn of speed. The steps taken to counter them helped lead to the unification of the RFC and RNAS on All Fool's Day, 1918.



The Gotha G VII was developed during 1918 as a long-range photo-reconnaissance aircraft, deleting the nose armament for extra speed. The wings were slightly swept to compensate for the stunted nose.

with plywood and fabric covering, the G IV was of three-bay biplane configuration with a basically square-section fuselage, braced tail unit and tailskid landing gear incorporating twin-wheel main units. The twin-engine powerplant, comprising two Mercedes D.IVa inlines strut-mounted between the wings, directly above the main landing gear, was arranged to drive pusher propellers, a large cut-out being provided in the trailing edge of the upper wing to give the necessary propeller clearance. The G IV was followed by an improved **G V** that was basically the same, but introduced improved equipment and a number of refinements, including cleaner, more streamlined engine nacelles. The **G Vb** was a derivative with a pair of auxiliary wheels mounted forward of each main landing gear unit to reduce the danger of nosing-over during night operation.

A number of Gotha G series aircraft followed the G V, mostly built in ones or twos.

Specification

Gotha G V

Type: three-seat long-range bomber

Powerplant: two 260-hp (194-kW) Mercedes D IVa 6-cylinder inline piston engines

Performance: maximum speed 140 km/h (87 mph); service ceiling 6500 m (21,325 ft); range 500 km (311 miles)

Weights: empty 2740 kg (6,041 lb); maximum take-off 3975 kg (8,763 lb)

Dimensions: span 23.70 m (77 ft 9in); length 11.86 m (38 ft 11 in); height 4.30 m (14 ft 1.25 in); wing area 89.50 m^2 (963.40 sq ft)

Armament: two 7.92-mm (0.31-in) Parabellum machine-guns on pivoted mounts in nose and dorsal positions, and a bombload of 300 to 500 kg (661 to 1,102 lb) according to range of mission

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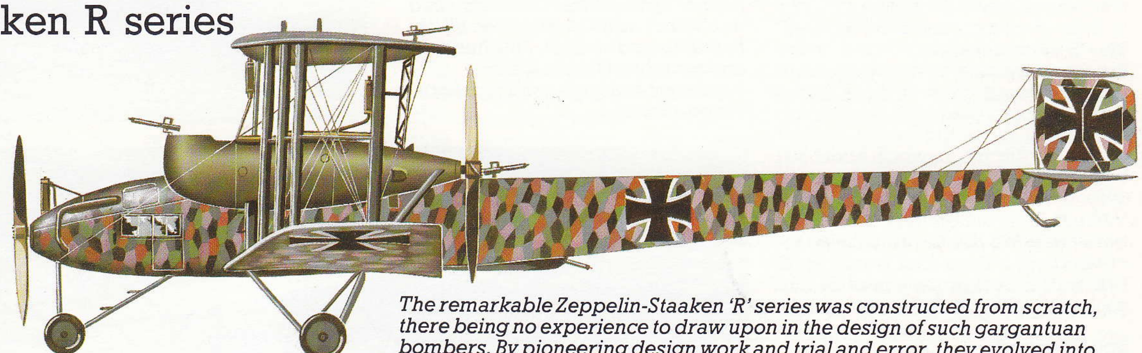
GERMANY

Zeppelin-Staaken R series

Soon after the beginning of World War I Count von Zeppelin initiated the development of heavy bombers which he could foresee would be of great importance to the nation's war effort. The design of landplane versions began under the leadership of Professor Baumann, the first of them being the **Zeppelin-Staaken V.G.O.I** which established a basic layout and size for the remainder of these giant aircraft. With biplane wings, a slab-sided fuselage and biplane tail unit, the V.G.O.I was supported on the ground by fixed tailskid type landing gear, whose main units had multiple wheels, plus two more wheels beneath the nose. First flown on 11 April 1915, the V.G.O.I was found to be underpowered and was re-engined. The production **R VI**, of which the first was delivered in June 1917, eliminated the powerplant from the fuselage nose. R VI production totalled 18, one being built by the company and the remainder under subcontract by Aviatik (six), Ostdeutsche Albatros Werke (four) and Schütte-Lanz (seven). They were followed into production in 1918 by the similar **R XIV** (three aircraft) and **R XV** (three aircraft), both versions having five Maybach Mb.IV engines. An advanced four-engine version developed by Aviatik, with one 220-hp (164-kW) Bz.IVa and one 530-hp (395-kW) Bz.VI in each nacelle, was allocated the designation **R XVI (AV)**; three were to have been built but only one was completed before the end of the war. Variants included the single **R VII** which differed from the R IV by having two Mercedes D.IIIs in the nose and four Benz Bz.IVs in the nacelles; the **Type L** twin-float seaplane with four 260-hp (194-kW) Mercedes D.IVa engines; and three **Type 8301** twin-float seaplanes which had the same powerplant but introduced an entirely new fuselage.



The remarkable Zeppelin-Staaken 'R' series was constructed from scratch, there being no experience to draw upon in the design of such gargantuan bombers. By pioneering design work and trial and error, they evolved into seven-man bombers able to carry a substantial payload.

Specification

Zeppelin-Staaken R VI

Type: seven-crew heavy bomber

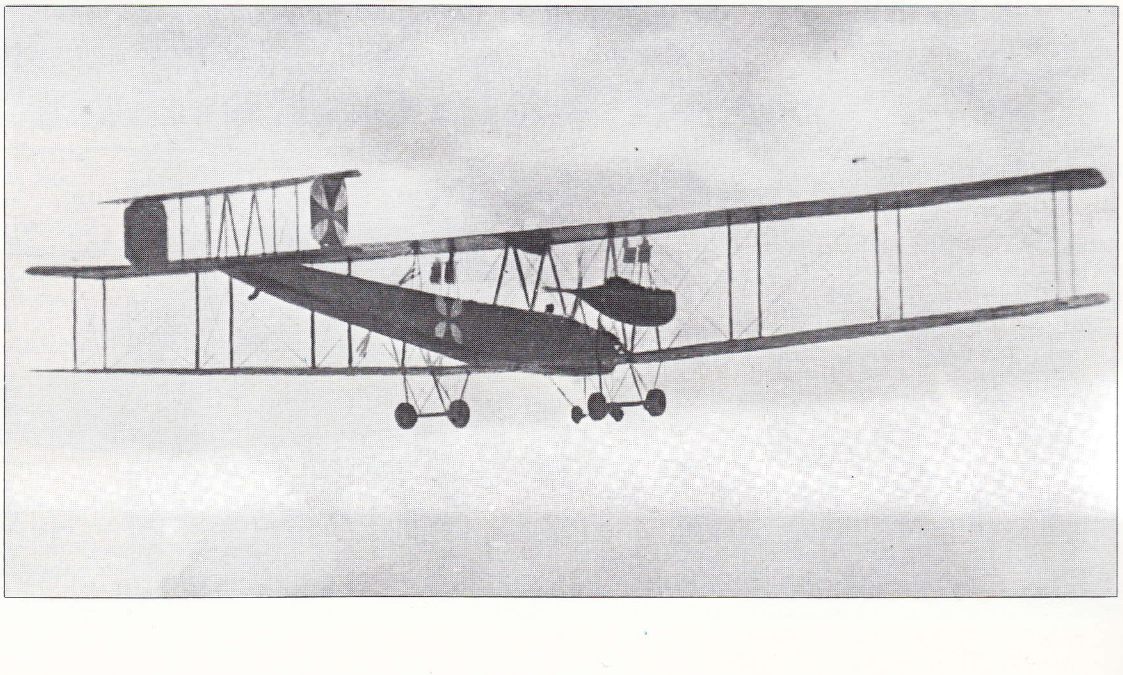
Powerplant: four 245-hp (183-kW) Maybach Mb.IV or 260-hp (194-kW) Mercedes D.IVa inline piston engines

Performance: maximum speed 135 km/h (84 mph); service ceiling 4320 m (14,175 ft); maximum duration 10 hours

Weights: empty 7921 kg (17,463 lb); maximum take-off 11848 kg (26,120 lb)

Dimensions: span 42.20 m (138 ft 5.5 in); length 22.10 m (72 ft 6 in); height 6.30 m (20 ft 8 in); wing area 332.00 m^2 (3,573.74 sq ft)

Armament: four 7.92-mm (0.31-in) Parabellum machine-guns, plus a maximum short-range bombload of 2000 kg (4,409 lb)



An R IV in flight made an impressive spectacle. Early models suffered terribly from engines blowing up, often during take-off or prolonged climbing, which strained them to the limit. The first R IV to be delivered made a solo attack on London in February 1918, scoring a direct hit on St Pancras railway station.

Finland

Although theoretically a neutral country, Finland signed a treaty with the USSR in 1948 which requires her to fight any aggressor attacking the USSR across her territory. In case of this happening the Soviet Union would provide either direct military assistance or aid as required by the circumstances. Despite these treaty limitations and the restrictions they place on its armed forces, Finland has developed its own arms industry which manufactures armoured vehicles, artillery pieces, mortars and small arms for the home market and, by certain expediencies, for the export one as well. However, major weapon systems have tended to be bought from the USSR and Sweden for political reasons, with occasional purchases from France, the UK and the USA.

The Army

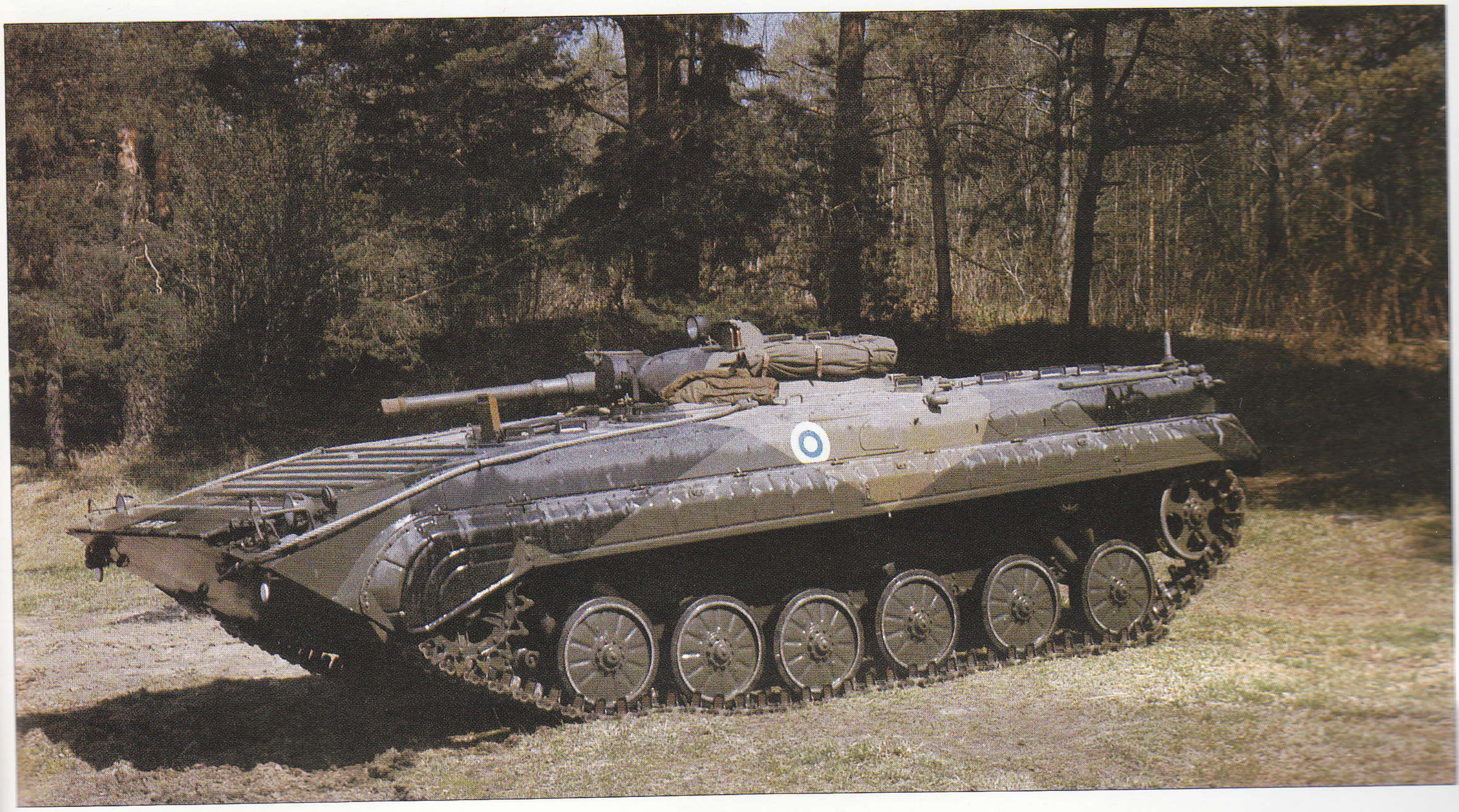
At the moment the Finnish army comprises some 30,900 men of whom 22,300 are short-term conscripts. They form the following front-line units:

one armoured brigade (of one tank battalion, one armoured infantry battalion, one field artillery battalion plus supporting units),
six infantry brigades,
seven independent infantry battalions,
one commando infantry brigade,
two field artillery regiments,
two independent field artillery battalions,
two coastal artillery regiments,
two independent coastal artillery battalions,
one mobile coastal artillery battalion,
one air-defence regiment (including a SAM battalion),
five independent air-defence battalions,
two engineer battalions,
one signals regiment, and
one signals battalion.

The Finnish armed forces use a mixture of Soviet and indigenous equipment; Finnish infantry are mainly armed with derivatives of the Soviet AK-47 manufactured to high standards at Valmet.

Until 1960 the army used mainly ex-German and ex-Soviet World War II armoured equipment refurbished in Finland. This *matériel* was initially supplemented and then supplanted by more modern Soviet vehicles. During the late 1960s and early 1970s the initial deliveries were supplemented by other small purchases. On the MBT front about 100 T-54 and T-55s were purchased, the former being relegated to training or having their turrets taken off for static defence roles. In 1980 a major re-equipment programme was started for the Parola Armoured Brigade. The tank component was upgraded by an order in 1984 to the USSR for 100 of its T-72 MBTs armed with a 125-mm (4.92-in) main gun. BTR-50 APCs are also being replaced by the BMP-1 ordered in 1980 as the first phase of the modernization programme. At the same time the opportunity was taken to replace the Soviet BTR-60 wheeled APCs used in small numbers by the infantry brigades, and several hundred locally designed and built SISU XA-180 wheeled APCs have been ordered for delivery from the mid-1980s onwards. In

In 1980 Finland embarked on a modernization programme for the Parola Armoured Brigade. The mechanized infantry are re-equipping with the BMP-1 MICV illustrated here, while the armoured battalion has received 100 T-72s to replace its obsolescent T-54/5s.



12 PASS

Finland's dense forests and multiplicity of lakes and bogs severely limit the employment of conventional artillery, so Tampella have produced a range of excellent mortars.

terms of artillery the Finns rely on both indigenous and foreign-built models, the firm Tampella being especially prominent with several highly successful designs. Like most Scandinavian countries, Finland's coastlines require great emphasis to be placed on coastal artillery, and weapons up to 152-mm (6-in) calibre are found.

A full list of the equipment used by the army includes:

Armour: PT-76 light tank; T-54 (training), T-55 and T-72 (on order) MBTs; and BTR-50PK/50PU, BTR-60PB/60PU and SISU XA-180 APCs;
Artillery: (towed) 76-mm (3-in) M/02, 76-mm M/36, 105-mm (4.13-in) M/41, 122-mm (4.8-in) M60 and 130-mm (5.12-in) M/56 field guns; 105-mm M/37/10, 105-mm M61/37, 150-mm (5.91-in) M/40 and 152-mm (6-in) M/38 howitzers; and 155-mm (6.1-in) M/74 gun-howitzer;
(coastal) 100-mm (3.94-in), 130-mm and 152-mm; and
(mortars) 60-mm (2.36-in), 81-mm (3.2-in); 120-mm (4.72-in) and 160-mm (6.3-in);
Air-defence: (towed) 20-mm Flak 38, 23-mm ZU-23, 30-mm, 35-mm GDF-002, 40-mm L/60 and L/70 Bofors and 57-mm S-60;
(self-propelled) ZSU-57-2; and
(SAM) SA-3 and SA-7;
Anti-armour: 55-mm M55 rocket-launcher; 75-mm Miniman LAW; 95-mm (3.74-in) 95 SM58-61 recoilless rifle; and SS.11, TOW and AT-4 'Spigot' ATGWs; and
Small arms: 9-mm M35 and 7.65-mm Parabellum pistols; 9-mm M31 SMG; 7.62-mm M62 rifle; and 7.62-mm M62 and 7.62-mm M32 MGs.

To supplement the regular forces there are 700,000 reservists for all the services, and these would be mobilized to create units of up to brigade strength for the army within seven Military Areas.

The Navy

The Finnish navy is like the other services in being limited in size, having only 2,700 men of whom 1,400 are conscripts. A plan to increase its capabilities was announced in 1974 but monetary problems had by 1980 severely limited the scope of this programme. The main offensive capability is centred on a small force of missile craft which is being increased in numbers by the building of the 'Helsinki' class armed with Swedish RBS15F SSMs. The last of the Soviet-built 'Riga' class frigates has been converted to a minelayer, whilst treaty limitations prevent the acquisition of any submarines. A four-vessel class of fast attack craft based on the 'Helsinki' design is also being procured to introduce greater commonality into the fleet. A full listing of the current and future fleet is:

Corvettes: two 'Turunmaa' class;
Missile craft: one 'Isku' class (trials), four 'Tuima' class, two (+10) 'Helsinki' class;
Fast attack craft: six 'Nuoli' class and four 'Helsinki' class (planned);
Coastal patrol craft: one plus four building;
Large patrol craft: five;
Large minelayers: three;
Inshore minesweepers: 13;
Amphibious warfare: 11 coastal transports and 14 LCUs;
Icebreakers: nine plus two building; and
Miscellaneous: 10.

The Air Force

The Finnish air force has 2,900 men, including 1,300 conscripts, and is tasked with defending Finnish air space. To do this it is divided into three fighter wings, which are each assigned to an air-defence district. Although there is only one fighter squadron per wing, the equipment is relatively sophisticated. The aircraft include 27 Soviet-supplied third-generation MiG-21bis 'Fishbed-N' multi-role aircraft, 12 new-build Swedish Saab J35S Drakens and six refurbished J35F Drakens. A further 20 or so J35Ds are to be delivered to equip a fourth squadron from the mid-1980s if funds permit.

To provide tactical reconnaissance there is a flight of six first-generation MiG-21 'Fishbed-C' day fighters, whilst to train fighter pilots in operational techniques there is an OCU with eight BAe Hawks, three Saab J35Cs, a few modified J35BSs and up to eight MiG 21U/UMs. The fighter squadrons use AA-2 'Atolls' on the MiGs and a mixture of Rb27 radar-guided and Rb28 IR-guided Falcon missiles on the Drakens. For primary and basic training duties there is a fleet of 30 locally designed and built Valmet Vinka piston-engined trainers with 15 Fouga Magister and 27 Hawk jet trainers, both licence-built. A further 15 Hawks are due to replace the Magisters in due course. The transport inventory is minimal, including only three Fokker F.27 Friendship Mk 100s and three multi-role Learjet 35As. Rotary-wing duties (including SAR missions) are undertaken by six Mil Mi-8 'Hips' and two Hughes 500s. No expansion in either area is seen in the foreseeable future.

To assist the armed forces there is also a Frontier Guard of 3,500 men in seven battalions and a 600-man Coastguard. The latter has some 50 patrol craft of various sizes and three Mi-8 helicopters.

DK-261
DK-269

The Finnish air force flies a combination of Western and Soviet aircraft; Saab J35 Drakens have been produced under licence at Valmet, while others were purchased direct.